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Tank Block Problem Solved at Corning

Developments of Revolutionary Character Have Taken Place
New Block Material Melted in Arc Furnace and Cast in Mold

Once more the Corning Glass Works, of Corning, New York, whose staff of technologists had already acquired world-wide distinction through past achievements in glass research and in translating research results into practical realities, has developed to the commercial stage a most important undertaking—one, it is believed, that will prove of great benefit to the glass manufacturing industry.

This accomplishment is the creation, through five years of painstaking investigation, experiment and test, of an entirely new type of tank block, made by a novel method and possessed of properties that will enable it to stand up under the tremendous strains imposed by high temperatures and the corrosive action of glass during the melting process, for a period (conservatively estimated from results obtained in various tests and in actual use) at least three times as long as the clay block in general use at present.

The new block has passed the experimental stage and been used with decided success in the commercial production of different kinds of glasses over long periods in the Corning Glass Works' own plant.

The blocks may be made with a wide range of compositions, but for use in lime glass tanks, the composition selected is approximately that of mullite, with about 70 per cent alumina and the rest largely silica. Originally, the blocks were made with about 62 per cent alumina to approximate to the composition of natural sillimanite. This material was found to contain a good deal of glassy matrix, as was indicated by the high polish which a piece of the material would take. An analysis of the long needles found in the pipe in the center of the casting gave 72 per cent alumina, so this composition was tried, resulting in a material showing a rock-like structure, which would not take a polish. Laboratory experiments proved that this mullite material is more resistant to corrosion by lime glass than the sillimanite material.

The true density of the mullite material varies with the composition from 3.0 to 3.4.

The method of making the blocks is by mixing diaspore or bauxite with more or less sand or kaolin and melting it at a temperature of over 1800 deg C. in an arc furnace such as is used in making alundum and other abrasives, but which is mounted on trunions to permit of the furnace being tilted and the "metal" being tapped directly into molds, periodically.

The specifications accompanying the application for a patent filed by Dr. Gordon S. Fulcher of the Corning Glass Works, cover "cast refractory articles and method of making same."

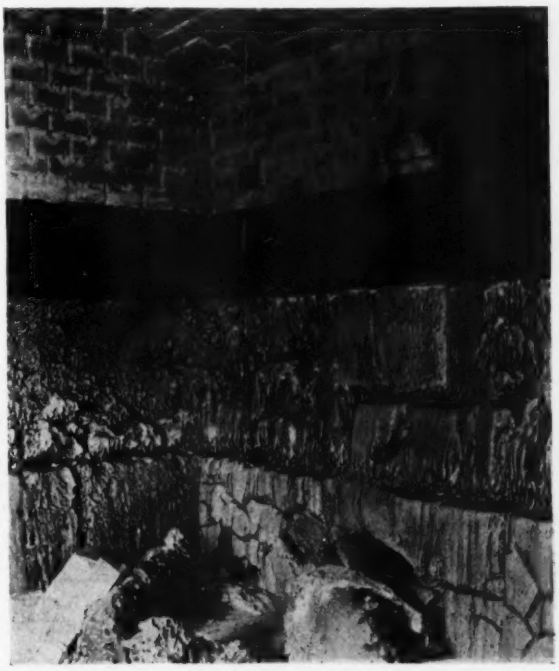


FIG. 1. CAST BLOCK AFTER RUN IN TANK 1C, MAKING BULB GLASS
(February to June, 1923)

The idea of casting such material is not new but previous attempts to secure sound blocks have failed because the neces-

sary precautions were not known. The blocks must be cooled slowly to avoid cracking, four days being required to cool a 200-pound block. When cool, and removed from the mold, the block is in finished condition ready for use.

The blocks must be made to proper size as the castings are so hard they cannot be chipped successfully and to grind them would be a slow and expensive process.

The superiority of cast blocks over burned or sintered

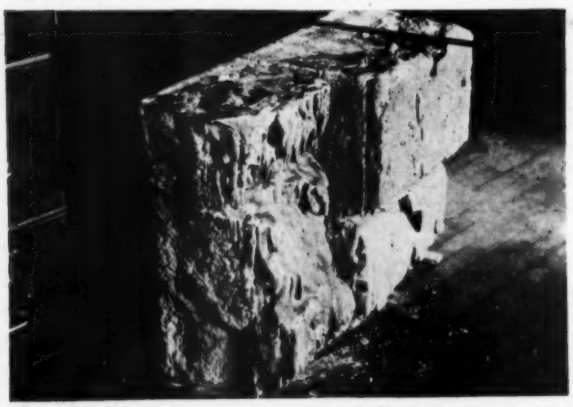
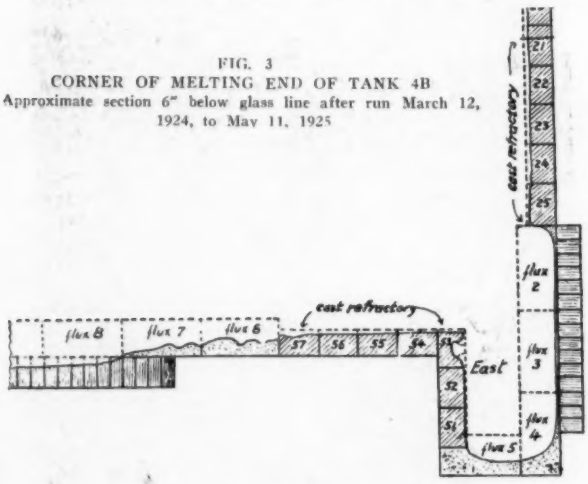


FIG. 2. CAST BLOCK AND FLUX BLOCKS AFTER FIVE MONTHS RUN IN TANK 1C

blocks of the same chemical composition in resistance to erosion by glasses and slags is a logical result of the greater density and more compact crystalline structure of the cast material. The crystals are larger and more closely packed than in refractory materials made of fragments of broken crystals, even though these be heated afterwards to near the

FIG. 3
CORNER OF MELTING END OF TANK 4B
Approximate section 6" below glass line after run March 12, 1924, to May 11, 1925



fusion point so that re-crystallization takes place. The cast material in which the crystals are indigenous, that is, have grown *in situ* from a fusion, is necessarily more dense and more free from pores. Also, cast refractory articles are much stronger at high temperatures than prior types of refractory articles at similar temperature, the softening temperatures at which they yield appreciably being considerably higher. The resistance to corrosion by molten glass is also considerably greater.

In the manufacture of blocks by the casting process, no binder is used. The grinding, molding and sintering operations are avoided. In a sintered article the dependence of the final resistance of the material to both corrosion and fracture on the resistance of the bond, which necessarily is soluble and fracturable, is removed, because no binder is present.

Each of the cast blocks contains a "pipe" of about 10 per cent of the volume of the block, produced during the casting operation, but this does not seriously decrease the value of the block.

No difficulty has been encountered in the case of blocks used in glass tanks, on account of spalling. Standard size brick 9 by 4.5 by 2.5 inches are more difficult to make and more likely to crack on heating.

The thermal conductivity of the mullite material is about twice that of fire brick. The thermal expansion is a regular function of the temperature and is about the same as fire

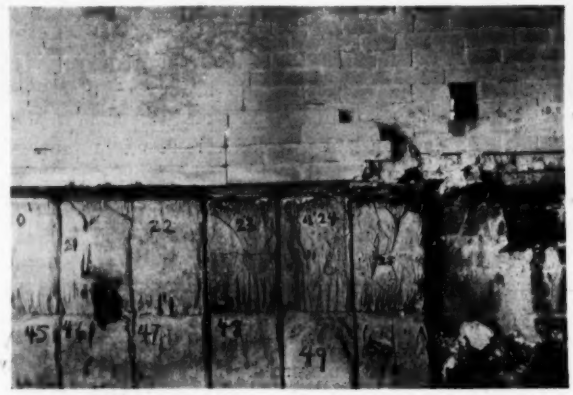


FIG. 4. CAST BLOCKS IN BACK WALL OF TANK 4B

brick (5×10^{-6} per deg. C.) though some measurements indicate that it may be somewhat lower.

The softening point is considerably higher than that of fire brick. A very severe test in which fire brick showed deformation beginning at 1100 deg. C., gave 1450 deg. C. to 1600 deg. C. for various samples of cast mullite.

How the New Cast Block Was Developed

The evolution of the new block makes an interesting story. Development began in 1921. Some irregular-shaped chunks of fused sillimanite were obtained and ground into the form of rectangular blocks, then tested in a glass furnace, with promising results.

Some time later, a 300-pound block was cast and tested in a furnace melting bulb glass (Fig. 1). Its condition, in comparison with that of the adjacent clay blocks after the run lasting from February to June, 1923, is illustrated in Fig. 2.

Following that one, service tests were made later on four blocks placed for fourteen months in another glass furnace.

Then, half of the melting end of a bulb tank, for which no air cooling was provided, was lined with the new material 8 inches thick. The dog-house at the west corner (not shown in the plan, Fig. 3) was lined with cast blocks ex-

FIG. 5. VIEW FROM EAST DOG-HOUSE, SHOWING CAST BLOCK 25 OF TANK 4B

clusively. In the dog-house on the east side and extending along the back wall of the tank were four 12-inch thick clay flux blocks, located as indicated and numbered respectively, 2, 3, 4 and 5 on the sketch. What happened to the blocks during the 14 months' run from March 12, 1924, to May 11, 1925, can be inferred from their condition when the tank was emptied, as recorded in Fig. 4, which is a front view of the wall, and in Fig. 5, where the side of the cast block 25 can be seen, exposed by the almost total destruction of flux block 2.

From the dotted lines in the sketch, Fig. 3, which indicate the original outlines of both cast and flux blocks at the time the furnace went into operation, and from the solid lines showing their final outlines, an idea can be had of the relative degree of disintegration of the two types of blocks.

Fig. 5, gives a direct comparison of their resisting power. It shows a view looking west through the east dog-house, and how the cast refractories, starting with the first block 25, stood up in a test that affected the adjoining flux blocks 2, 3, etc., so seriously that it became necessary to place brick against their outer faces to avoid a break.

The next important step in the progress of development was to line the entire melting end of a bulb tank with the new blocks. At the end of five months this tank was "let out"

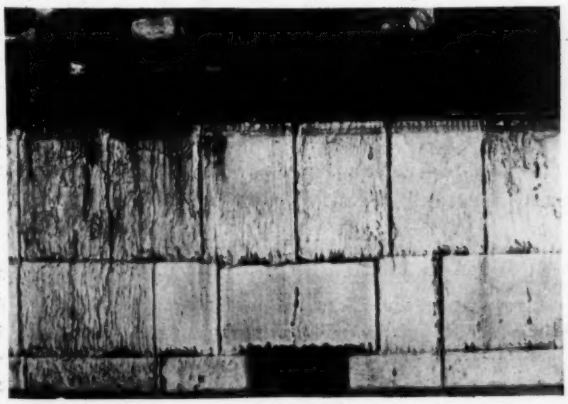


FIG. 6. CAST BLOCKS IN BRIDGE WALL, MELTING SIDE
(Temperature 1,410 deg. C.)

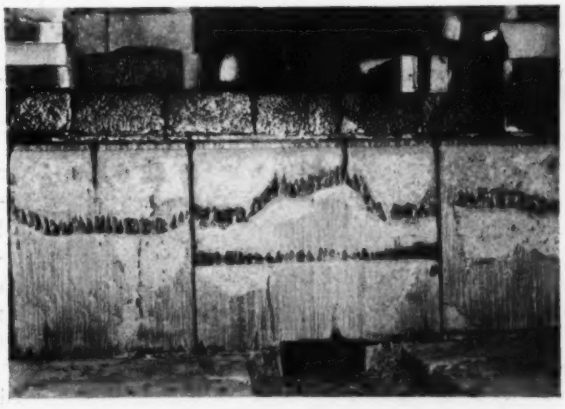


FIG. 7. FLUX BLOCKS IN BRIDGE WALL, WORKING SIDE
(Temperature 1,340 deg. C.)

on account of lack of orders on hand to keep it going. Comparatively slight disintegration of the mullite blocks had occurred, as seen in Fig. 6, which gives a view of the cast refractory side of the bridge wall in the melting end of the tank. This tank had been operated at a temperature of 1410 deg. C. In Fig. 7 the flux blocks which constituted the

FIG. 8. CAST REFRACTORY FEEDER BOWL, TUBE, COLLAR AND RING FOR PYREX TANK
(March to September, 1923)

other side of the same wall in the working end are shown, the temperature of this part of the tank during the run having been 1340 deg. C.

At present the main production bulb tank at the Corning plant is lined with cast blocks in the melting end, also partly

FIG. 9. MONKEY POT, 110 POUNDS
(October 13, 1924)

in the working end. The working end of one Pyrex tank also is lined with it.

Casting the Blocks

Various shapes besides tank blocks have been cast: feeder bowls and needles, rings, crucibles, and other similar products (Fig. 8). The adaptability of the material for mold casting purposes is illustrated by Fig. 9, the 110-pound monkey pot shown in this picture having been made by filling an inverted mold with the molten refractory material, allowing a few minutes time for the outer portions to set to the desired depth and then pouring out the remaining liquid.

In the manufacture of cast blocks the kind of mold used and the length of time the casting remains in the mold has a decided effect on the properties of the finished products. Different kinds of molds are required for different forms of castings. Iron molds are not satisfactory except for small, relatively thin castings.

The most satisfactory material for molds in which to cast blocks was found to be glass sand, baked with a binder such as linseed oil. The molds are made in six parts, one for each face of the block, and one inch thick. Projections and recesses assist in fitting them together. The separate pieces are held together in an angle iron frame, the top piece having an opening for pouring purposes.

After pouring, the block must not be allowed to cool too quickly or cracks will appear. The mold is, therefore, placed

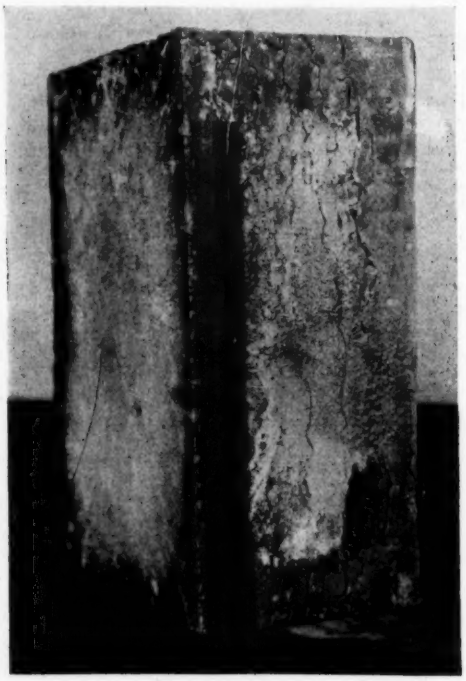


FIG. 10. FIRST STANDARD BLOCK CAST IN SIX-PART MOLD
(October, 1924)

on insulating brick and insulated on all sides and top and bottom with three to four inches of sil-o-cel powder, confined in a sheet iron container.

This "annealing" process allows the block to cool slowly, which is particularly important through the setting range of temperature, that is the range in which the material is changing from semi-plastic to rigid condition. This setting temperature is in the vicinity of 1550 deg. C.

A tank block 12 by 18 by 8 inches, when insulated with sil-o-cel will take about four days to anneal. Small castings must be annealed in kilns or given equivalent treatment.

Production and Sales Plans

Though the Corning plant is making cast blocks for its own requirements and can produce an additional quantity it is not equipped for large commercial production. Plans are being laid, however, for a new and complete manufacturing plant to be located near cheap electric power and be in operation by next summer, equipped to furnish blocks

to the trade in any desired quantities. At present production facilities are limited to blocks not exceeding a volume of 1.5 cubic feet (270 pounds), but it is expected that eventually blocks up to 48 inches high and weighing 1200 pounds will be made. Such blocks will eliminate horizontal seams.

The price at which the material will be sold will, it is said, seem reasonable if the prospective savings for the glass manufacturer are considered, including the elimination over long periods of shut-downs for hot and cold repairs, the increase in production capacity without additional investment for new mechanical equipment, the improved quality of ware because of less foreign material disintegrated from the walls of the tank, and the entire absence of stones in the glass because the new block dissolves evenly, not in lumps, like clay.

Until production on a larger scale has been carried out, the cost cannot be determined definitely. It has been stated authoritatively, however, that the price will not in any event be over $200 a ton.

Wide Application of the Invention

The Corning experiments were largely with aluminous siliceous refractories containing 65-80 per cent. Al_2O_3, and refractories consisting chiefly of alumina and silica (with 20-40 per cent silica), or of alumina, silica and zirconia (with up to 30 per cent zirconia), but the methods specified for making sound castings by this process are applicable to any refractory material that can be melted in and tapped from an electric furnace.

In the case of tank block materials with an annealing point so high that a sand mold cannot be used, the mold can be made of fused refractory material of equal or higher melting point than the refractory to be cast, the material being crushed to about 20 mesh or finer and bonded with linseed oil or other organic matter.

Application of the invention to boilers and elsewhere is a possibility. Tests by the Mellon Institute prove that mullite brick are far more resistant to erosion by a boiler slag containing 9 per cent iron oxide and 6 per cent lime (softening point cone 13) than ordinary fire brick. A test with open hearth slag will be made soon. With reference to spalling, while nine-inch mullite brick are much better than silica, they may not be as good as fire brick. However, it is believed that larger blocks of cast refractory, say 10 by 10 by 9 inches, will stand the most severe shocks in any furnace.

Strain and the Hot Water Test for Bottles

By D. J. McSwiney*

The hot water test for glass containers is used in many bottle plants and is considered a criterion of the degree to which the ware has been annealed, on the assumption that if the ware is strained it will be less able to stand an additional strain. As a matter of fact, however, badly strained ware may have a greater resistance to an outside mechanical stress than the same ware when so annealed as to be free from internal strain. Badly strained glass is harder, more elastic and has greater crushing and tensile strength than the same glass when annealed. It will often be noticed how difficult it is to break a bottle which has been cooled directly off the machine, compared with the same ware from the lehr. There may be little or no connection between the amount of heat shock which a bottle will stand on being filled with or plunged into a hot liquid, and the presence or absence of strain in the glass composing the bottle. However, so deeply rooted is the belief in the weakening action of internal strain that an actual comparison of the heat shock resistance of badly strained ware and of the same ware free from strain is necessary to convince most glassmakers. Such a comparison is given in the table on the following page.

The heat shock which a bottle will stand depends to a considerable extent on the way the shock is applied. In the tests, the results of which are given above, the heat shock was effected in two ways. In the case of ware which in practice is filled hot, the bottles were brought to a definite temperature in a cool chamber and were then filled, one at a time, by placing them on an iron slab and filling as rapidly as possible through as large a funnel as the bottles would accommodate, starting with hot water below the temperature which practice had shown the bottles would stand and gradually raising the temperature of the water used until breakage resulted; the bottles being brought uniformly to the same low temperature before each test with hotter water. In the case of ware which is pasteurized in commercial use, the bottles were filled with cold water at a definite temperature and plunged into hot water, the temperature of the hot water being gradually raised, that of the cold water being maintained uniform until the bottles broke or checked.

The ware designated as unannealed was cooled directly from the machine by allowing it to stand on an asbestos board in an open space, free from draughts. Polariscope examination of this ware showed it to be badly strained. The unannealed ware tested was in each case the residue of a much larger number set aside to cool, those tested being the bottles which did not break or check on cooling. This may have served to eliminate the ware which was weak through poor distribution, lack of homogeneity or other defects, but at the same time it presents the extreme of internal strain, the bottles probably being about as badly strained as they could be and still hold together. The ware designated as annealed was as good or better in this respect than the average of commercial ware.

The results obtained are too erratic to allow any definite conclusion to be drawn from them regarding the exact effect of strain in glass on heat shock resistance, but it is very evident from them that the presence of strain in glassware does not necessarily lower the resistance of the ware to heat shock but may, in fact, increase this resistance. This is true

* Consulting Chemist, Columbus, Ohio.

of the types of strain ordinarily present in glassware, such as those resulting from poor lehrs or lehr operation. However, it is probable that some strains can weaken ware in this respect, for example, the presence of severe tension in the bottoms of glass containers which are filled hot.

It will be noted that the greater part of the strained ware shows, on an average, a slightly higher heat shock resistance than the annealed ware; not enough, however, to indicate that internal strain improves the resistance to heat shock, but sufficient to show that a strong strain, and in the case of the gallon packers, strains of varying intensities do not have any pronounced effect of lowering the resistance to heat shock. More conclusive results could probably be obtained by the examination of a large amount of strained ware as compared with similar ware when annealed. The greatest improvement in heat shock is shown by the unannealed pint fruit jars as compared with the annealed jars. The effect of the strain in the case of such wide mouth ware might differ from that with narrow mouth ware in that the cooling of the inner surface of wide mouth ware by the circulation of the gases in the lehr, might cause a difference in the distribution of the strain between the surfaces and the center of the glass walls. In the unannealed ware, the intense strain was general throughout the ware. It is quite possible that ware which is only locally intensely strained would show a lowered resistance to heat shock.

The only practical means of correctly judging whether or not glassware contains internal strain is by means of a polariscope or strain finder. Most glass plants are now equipped with these instruments, but in many cases they are incorrectly used or are not used at all. The lens of a strain finder should be equipped with a selenite or similar plate so that the strain will show as contrasting colors. For example, blue on a red background, instead of the bluish-grey shadows which otherwise show. In this way slight strains can be made evident which otherwise would not be apparent.

Comparison of Heat Shock Resistance of Strained and Annealed Ware

Style of Ware	Condition of strain	Number tested	Approximate temperature range heat shock	Average breaking temperature differential	Breakage internal hydraulic pressure	
8 oz. Ketchup	Annealed — slight strain bottom	12	212° F—47° F	164° F	.....	Bottles filled with water at 212° F. Temperature of bottles progressively lowered until breakage resulted.
Same	Unannealed	4	212° F—50° F	158° F	.....	Same
12 oz. Grape juice	Annealed — slight strain bottom	12	45° F—205° F	162° F	.....	Bottles filled with water at 45° F. and plunged into hot water, temperature of which was slowly raised.
Same	Unannealed	10	45° F—205° F	167° F	.....	Same
Pint fruit jars—Flint	Almost free from strain	10	50° F—200° F	148° F	.....	Bottles cooled to 50° F. and filled with water of gradually increased temperature.
Same	Unannealed	3	50° F—200° F	160° F	.....	Same
Gallon packers—Flint	Well annealed—slight strain bottom	6	60° F—212° F	148° F	.....	Bottles cooled to 60° F. and filled with water of increasing temperature.
Same	Unannealed	2	60° F—212° F	149° F	.....	Same
Same	Slight strain sides—mild strain bottom	6	60° F—212° F	146° F	.....	Same
Same	Sides well annealed—strong strain bottom	6	60° F—212° F	141° F	.....	Same
Same	Poor distribution—Heavy and strained bottoms	4	60° F—212° F	134° F	.....	Same
16 oz. Round prescription—Amber	Annealed	8	50° F—212° F	158° F	.....	Bottles filled with water at 50° F. and plunged into boiling water.
Same	Unannealed	6	50° F—212° F	162° F	.....	Same
12 oz. Emerald green soda	Annealed	6	50° F—200° F	151° F	Average 380 lbs. per sq. in.	Same
Same	Unannealed	6	50° F—200° F	150° F	580—620 750*—750*	Same
8 oz. Flint soda	Annealed — very light strain throughout	6	50° F—200° F	144° F	Average 425 lbs.	Same
Same	Unannealed	5	50° F—200° F	146° F	900*—900*	Same

*Did not break.

If the presence of strain in glass can improve the mechanical properties of the glass, it might be asked what is the necessity of annealing. The action of internal strain in improving the mechanical strength of glass applies only to external mechanical stresses. As soon as the outer layers of the glass are ruptured the internal strain will cause breakage of the glass. In the case of glassware which is to be cut, polished or otherwise treated, so that the surface layers are broken, the presence of strain always means increased breakage and the same thing is usually true of large containers. However, with smaller glass containers or other articles which are used as they are formed hot, this is not necessarily the case. A bottle may be badly strained and yet live a long and useful life without giving trouble. Such a bottle, however, is as uncertain as a dud shell, and it might burst at any time, apparently spontaneously. From the examination of soda or champagne bottles or similar ware which is subjected to a constant and high pressure over considerable periods of time, it appears that the resistance of glass to a constant strain is not constant but that instead this resistance decreases continuously. This would explain the apparently spontaneous breakage of badly strained ware for, in this case, the resistance of the ware as made would be greater than the internal strain, but the glass being constantly subjected to this internal strain, its resistance would gradually decrease until the strain exceeded the resisting power of the glass, when breakage would result. With strains of medium and low intensity and in the case of containers which are not large, it is probable that the presence of such strains are of no practical importance. For all practical purposes, well made glass containers up to 16-ounce size, or even larger, are just as good when only mildly strained as they are when perfectly annealed. It is, in all probability, a waste of money and effort to try to so refine the annealing means as to get such ware perfectly free from strain.

A determination of the internal hydraulic pressure which bottles will stand is often made as a routine test, especially on pressure ware and milk bottles. As shown in the above tests, the presence of a strong strain in the ware can have a pronounced effect on the results obtained in this test. In general, a bottle which is strongly and uniformly strained will show about double the resistance to internal hydraulic pressure that is shown by the same bottle when well annealed. However, this effect of internal strain on hydraulic pressure resistance appears to fall off sharply with decrease in the intensity of the strain.

While the presence of strain in the ware will have little or no effect on the resistance of the ware to heat shock, so that the hot water test is of no value as a test of annealing, this test may be of considerable value in judging the way any ware can be expected to stand up when subjected to heat shock in use, provided the conditions under which the heat shock tests are carried out in the plant are comparable with those to which it is subjected in use. The value of the plant test will also depend largely on the ability to maintain constant all the factors which will influence the test. For example, with some ware a considerable difference in the results can arise from slight variations in the method of filling with the hot liquid. If the inflowing stream of hot liquid is allowed to impinge on the side of the bottle near the junction with the bottom, the apparent resistance of the ware may be much lower than if the hot liquid first impinges on the center of the bottom and gradually rises along the sides. Again the rate at which the hot liquid is filled into the bottle can influence the results obtained.

In general the following factors will influence the resistance of the ware to heat shock, whether in a plant test or in actual use: The composition of the glass, the size and shape of the ware and thickness of the walls and bottom, the uniformity of distribution of the glass in the ware, the presence or absence of checks, cords, blisters, variations in glass composition or other defects, the character of the hot liquid and the way it is filled into the ware, the temperature differential between the glass and the hot liquid, the character of the medium in contact with the side of the glass opposite to that with which the hot liquid comes in contact and the rate at which the bottles and the hot liquid are brought into contact. A factor which may have some influence in this respect is the "nature" of the glass composing the bottles. However, too little is known of this property to be able to judge what its effect might be.

While glass composition is a most important factor in heat shock resistance, the majority of the American bottle glasses do not vary sufficiently in composition for this factor to cause much difference. In general, decrease in the soda content of the glass and the substitution of magnesia for lime, improve the resistance of the glass to heat shock. The larger the ware, the more irregular its shape. The thicker the glass walls and the sharper the difference in thickness between adjacent portions of the ware, the less will be its resistance to heat shock. With any particular style of ware made at a plant, the factor which is probably most likely to lower the heat shock resistance and the one to which, in this respect, the least attention is usually paid, is the degree of uniformity of distribution of the glass in the ware. The effect of poor distribution will be seen in the results obtained on the gallon packers in the above test. Points of sharp differences in character present in the ware, such as the zone surrounding a large blister, are always weak spots and the glass at such points is always more likely to give way under a severe strain. The effect of most of the various liquids filled hot into glass containers is much the same. However, the higher the specific heat of the liquid the greater is its effect. Any bottle will stand only a definite difference in temperature between the hot liquid and the glass, if the temperature difference is greater than this the bottle will break. This is a point of great importance with hot filled ware, especially with large ware. The temperature of the hot liquid as filled into the bottles is usually constant, the temperature of the bottles as they are filled should then, at all times, be sufficiently high so that the temperature differential between the two materials is less than the breaking temperature differential of the bottles. The average user of bottles knows little or nothing concerning the temperature shock which a bottle will stand and at times ware will be taken from a very cold yard or storage house and sent directly to the filling machines.

The Glass-Making Methods and Batches of Twenty-five Hundred Years Ago

Ancient Tablets Add to Our Knowledge of Assyrian Practice

Information of absorbing interest to persons concerned with the origin and early history of glass-making have been disclosed by the decipherment of the texts of a number of cuneiform tablets in the possession of the British Museum, some of them bearing the colophon of "The Library of the Temple of Nabũ," which have been translated into English by R. Campbell Thompson, M.A., D.Litt., F.S.A., Fellow of Merton College, Oxford.

The methods followed by the translator and the results of his work have been published by a London firm in the form of a book printed by a typewriting reproduction process and entitled "On the Chemistry of the Ancient Assyrians."

It had been known for some time that the text of the tablets related to chemical subjects but never before had they been fully translated and what work had been done on them had not been of much assistance to practical chemists in estimating the technique of the Assyrians in glass-making.

Thompson's book, however, gives in actual details the methods in vogue in Assyria in the seventh century, B. C., not only of making the different frits and glasses but also the various coloring agents added to them. With the exception of one text, none of the thirteen tablets translated by him has previously been published. A part of the text, K 203 (Plate I), is reproduced here.

The importance of these texts for the history of glass, dating as they do to the period of Assurbanipal (668-626 B. C.) cannot be overrated. Not only do they give the Assyrian names for the different kinds of glass and glazes but also the actual formulas for the components and proportions for their manufacture.

In approaching the problem of translating the texts, Thompson first considered the principles involved in the techniquè of modern methods of glass-making and compared them with data obtained from the Assyrian texts, deducing therefrom the components of the Assyrian glasses.

He also discusses the sources of raw materials used by the Assyrians and shows how the colors used in the making of the glass were produced.

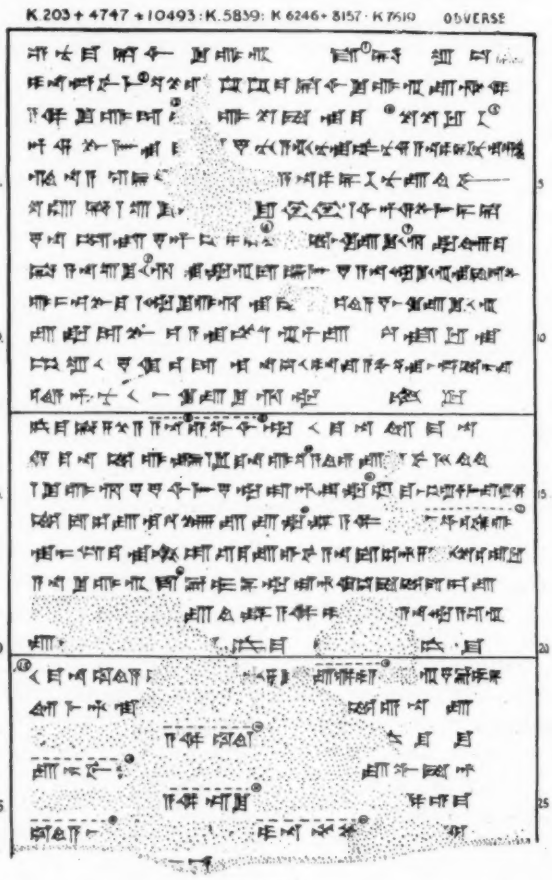


PLATE I

The different forms of glass are considered. "Sirṣu," for instance, is a simple glass, composed of

60 parts sand
180 parts alkali of salicornia
5 parts saltpetre
2 parts chalk

(In the Assyrian receipts the proportion of alkali is far greater than that prescribed in modern glass-making, probably because the Assyrian products were less pure.)

Besides glass, several of the texts treat of miscellaneous chemicals and minerals and information is given concerning their manufacture and uses.

Leaving out of consideration the weird ceremonies that accompanied glass - making operations in those days, when superstition was a stronger force in men's lives than it is today, the translated texts in their complete form prove that the glass-workers of twenty-five hundred years ago possessed a surprisingly large fund of knowledge concerning their raw materials and how to use them.

"We may regard these texts as having been made with great exactitude for the benefit of craftsmen of every capacity and degree," remarks the translator.

The Making of Assyrian Glass

Translations of R. CAMPBELL THOMPSON

A. The Preparation of the Furnace

(L, 1). When thou settest out the ground plan of a furnace for "minerals" thou shalt seek out a favorable day in a fortunate month, and thou shalt set out the ground plan of the furnace. While they are making the furnace, thou shalt watch them and shalt work thyself, in the house of the furnace: thou shalt bring in embryos[1] (born before their time)

[1] [Translator's comment.] This use of the fetus or embryo in the preparation of the furnace is more a question for the anthropologist than the chemist. . . . Clearly the Assyrian idea is that the spirits of incomplete beings must be propitiated, on the grounds that they would have some mysterious influence over incomplete substances, *i. e.*, the glass which is in the process of being made.

. . . . : another, a stranger, shall not enter, nor shall one that is unclean tread before them: thou shalt offer the due libations before them: the day when thou puttest down the "mineral" into the furnace thou shalt make a sacrifice before the embryos: thou shalt set a censer of pine-incense, thou shalt pour kurunna—bber before them.

Thou shalt kindle a fire underneath the furnace and shalt put down the "mineral" into the furnace. The men whom thou shalt bring to be over the furnace shall cleanse themselves and then thou shalt set them to be over the furnace.

The wood which thou shalt burn underneath the furnace shall be styrax,[2] thick, decorticated billets which have not lain exposed in bundles but have been kept in leather coverings, cut in the month Ab[3]. This wood shall go underneath thy furnace.

B. The Making of the Frit

(L, 13). If clear (ibbu) blue glaze is for thee to make, thou shalt crush separately—

10 mana[4] of sand
15 mana of alkali-ash
1⅔ mana of stryax-gum

Thou shalt mix them together, and put them down in the furnace whereof the floor of the apertures is cold, and settle them evenly between the apertures. Thou shalt keep a good, smokeless fire burning until the "metal" is at a white heat: then thou shalt take it down into the furnace which has been let grow cold: then thou shalt keep a good smokeless fire burning until it liquefies: then thou shalt pour it on burnt brick and its name is ". . ." [name missing].

C. The Making of Copper Oxide

(L, 21). Thou shalt put 10 mana of copper into a clean melting pot: thou shalt put it down into the furnace which has been let grow hot: then thou shalt keep a fierce fire burning until the copper fuses. Thou shalt beat . . . thou shalt open . . . until the zukū-glass, and thou shalt spread the copper . . . on the roof (?).

D. The Making of Zukū-glass

(L, 34). If zukū-glass is for thee to make, thou shalt put down in the furnace . . . mana of ahuzzu-frit and settle it evenly between the apertures . . . it, and after one day thou shalt take it out and shalt let it cool: thou shalt put it down again into the furnace which has been let grow cold . . . . . thou shalt take it out: its name is zukū-glass.

E. The Making of Tersitu (blue frit or glaze from copper)

(L, 40). Thou shalt put . . . mana of zukū-glass down into the furnace which has been let grow hot: thou shalt keep a good, smokeless fire burning . . . thou shalt beat and crush it . . . and thou shalt again crush . . . copper . . . thou shalt put on the fire a stone jar of wine. . . . If the "metal" boils before the wine does so then thou shalt mix the "metal" with the copper: then thou shalt pour it on the burnt brick, and its name is tersitu (blue frit with copper).

[2] Probably, stryax-wood, a gummy wood.
[3] Ab, the hottest and dryest month of the year. Keeping a fire sufficiently hot was probably the greatest problem with which the Assyrian glass-maker was concerned. Above all things the wood must be dry.
[4] One mana = 60 shekels = 505 grams.

F. The Making of Blue Glass (Lapis)

Thou shalt crush separately—

10 mana of tersitu (blue frit)
10 mana of sirşu-glass
. . . . . of alkali, in small pieces, not round lumps
⅔ mana of chalk of the sea
Roasted cinnabar (= mercury?)

Thou shalt mix them together, collect them into a clean melting pot, put it down into the furnace whereof the floor of the apertures is cold, and thou shalt put it on a support evenly between the apertures, the base of the melting pot not touching the furnace; thou shalt keep a good, smokeless fire burning: when the fire from the middle of the apertures has driven forth the bubbles . . . and the "metal" glows, thou shalt draw the fire: when the furnace is cold, thou shalt take it out and crush it: then thou shalt collect it into a clean melting pot and put it down into the furnace which has been let grow cold: thou shalt keep a good, smokeless fire burning. While the "metal" is fusing thou shalt not shut the door of the furnace but after the "metal" has fused, thou shalt shut the door of the furnace, and they shall pierce the outside in front of thee with a hole; after they have pierced the . . . , thou shalt look, and if the "metal" runs, thou shalt pour it into a hot melting-pot, and when the furnace is cold, uknū ("blue glass") will come out.

G. The Making of Molded Blue Glass

(L, 61). Thou shalt add to—

1 mana of fine tersitu (blue frit)
⅓ mana of crushed sirşu-glass
⅓ mana of sand
5 kisal[5] of chalk.

and thou shalt crush it again; thou shalt collect it into a mold, closing it with a duplicate mold; thou shalt place it evenly between the apertures, and uknū merku (molded blue glass) will come out.

H. The Making of Molded Purple, or Violet Glass

(L, 65). Thou shalt keep a fire burning in the furnace for seven days; then thou shalt add to—

1 mana of tersitu ("blue frit")
3 mana of tarabanu šadda (manganese?)
10 kisal of sirşu-glass, "which . . ."
5 kisal of chalk (or lime) of the sea (of the middle of the sea) cinnabar
2 kisal of saltpetre
3 shekels of arsenic
5 kisal of male red alum
6 kisal of orpiment
6 shekels of styrax-gum

and thou shalt crush it again, and collect it in a mold.

Uknū merku . . . will come out.

I. Sandiver (Glass Gall)

(L, 71). Whatever will not sink to the bottom thou shalt put into the furnace, keeping the fire burning for seven days.

J. The Making of Pale Blue Glass

(L, 72).

3 mana of tersitu ("blue frit")
8 mana of zukū-glass
1½ mana of . . . .
12 kisal of saltpetre

the composition for uknū . . .

[5] Kisal = a fraction of a shekel.

K. The Making of Black (?) Glass

1 mana of tersitu ("blue frit")
2 mana of šadâ (ferric oxide?)

the composition for uknû . . . black (?) glass.

L. The Making of Brown (?) Glass

1 mana of tersitu ("blue frit")
1½ mana of šadâ (ferric oxide?)

the composition for uknû . . . brown (?) glass.

M. The Making of Red-Purple Glass

(L, 76). Thou shalt crush

1 mana of tersitu ("blue frit")
1½ mana of sirşu-glass
½ mana of sand

add together and collect it in a mold: thou shalt put it into the furnace and shalt keep a fire burning for seven days, night and all day . . . and uknû samu ("red-purple glass") will come out.

N. The Making of Inlaid Bronze

(L, 80). If inlaid (or enamelled ?) bronze is for thee to make thou shalt put down into the cold furnace

10 (?) mana of ahussa-frit
10 mana of ..... thou shalt crush

(The rest of the receipt on Pl.4 mentions uknû ("blue glass") and bronze, and some procedure with water.)

O. The Making of Red-Purple Glass

(L, 86). (Practically all is lost except the directions to pour the "metal" on burnt brick, the result being uknû samu.)

P. The Making of Sirşu natku

(L, 92). If sirşu natku ("melting (?) glass") be for thee to make, thou shalt mix together

5 mana of ash of salicornia-alkali
? mana of sand (?)
? ? of male salt(petre)
5 shekels of chalk.

Thou shalt put it down in a cold furnace: thou shalt keep a good fire burning, thou shalt pour it into water: thou shalt put it down in haragi (?) uncovered . . . thou shalt pour it into water. This is sirşu natku ("melting (?) glass").

Q. The Making of Sapphire

(L, 97). Thou shalt add to

.. mana of tersitu uknû ("blue frit made with copper")
1 mana of sirşu-glass

pound and rub together: thou shalt put them down into a cold furnace, keep a good fire burning, until they amalgamate. Then into the furnace which thou art keeping thou shalt put them down in haragi closed, uncovered: [6]thou shalt keep the fire burning, thou shalt pour it into water; thou shall put it down in haragi covered, ceasing (?) the moistening; thou shalt open it in four days, thou shalt take out sipru (sapphire) for bronze inlay (?) of the apprentice (?) (or learner (?)).

S. The Making of Green Crystal

(L, 4). Thou shalt add the same (?) to arsenic, and thou shalt again collect it into a mold: thou shalt cover the lower part of the mold, put it on a support, put it into the middle of the furnace, and seven days . . . thou shalt close up the furnace. On the tenth day thou shalt open it, take it out and thou shalt add to

1 mana of rust (?)
1 kisal of washed saltpetre
washings of oxide of tin (?)
1 kisal of chalk
1 kisal of alkali

again crushing and powdering thy second batch: thou shalt mix it and when it has been sifted, thou shalt let the fire burn up, thou shalt take out "green crystal," which has been turned twice.

T. The Making of Crystal

(L, 18). To

20 mana of sand
1 talent (60 mana) of salicornia-alkali
2 mana of salpetre
10 shekels of chalk
1 mana of oxide of tin (?)
6 shekels of pearl (?)

There will come forth dušû (crystal glass).

U. The Making of Yellow (?) Glass

(L, 15)

1 mana of zukû-glass
15 kisal of saltpetre
10 kisal of antimony

The composition of yellow glass.

V. The Making of Opaque Carnelian

(L, 18)

1 mana of dušû-glass
15 kisal of oxide of tin (?)

The composition for opaque red-stone (carnelian)

W. The Making of Opaque Alabaster

1 mana of dušû-glass
10 kisal of oxide of tin (?)

The composition of opaque alabaster.

X. A Preparation (magical ?) in Advance

(1, 22). Thou shalt add to

1 mana 3 shekels of zukû-glass
(That?) which is used for soldering gold
3 kisal of male saltpetre
3 kisal of kalgugu (rubrica?)

and the embryo thou shalt break up into its pieces, taking three parts of each: when thou hast taken them, thou shalt. . . Thou shalt put them into a cauldron in dung: thou shalt mix them up and then cover the dung with two spoonfuls of sand; thou shalt prepare it beforehand, when the ingredients are plentiful for thee.

Y.

(L, 34). In thy A. GUB (?)—vessel thou shalt heat the above; take out the embryo; take a sacrifice, make offerings (for the dead) for the workmen; collect the rest into a mold, put it down into the furnace. . . .

AA. The Making of Aventurine

(V, 3.)

.. mana of šadda (ferric oxide) (?)
10 mana of ahussa-frit
.. mana of unwashed saltpetre
½ mana of arsenic
(this is the clearing agent)

Thou shalt take out sandu marshašitu.

(= sandaresos, spangled red stone, aventurine.)

[6] The translator is at loss how to explain this passage.

CC.—The Making of Sirṣu-glass

(V, 13). To
20 mana of amnakki-sand
1 talent (60 mana) of salicornia-alkali
1⅔ mana of saltpetre
⅔ mana of chalk.

Sirṣu-glass will come out.

DD. The Making of Bahre (Red Coral ?)

(V, 16). To
1 mana of zukū glass
16 kisal of oxide of tin (?)
10 kisal of antimony
.. of saltpetre
½ kisal of gold

This is the discovery (or, the science) of . . . dayani. [The translator suggests that this receipt is the "Purple of Cassius.]

The Original Source of Glass

The question as to where and when glass was first made has been quite widely discussed during recent years. The newly-translated Assyrian glass texts tend to discredit the theory that Egypt was the original producer. The distinguished scholar, Prof. Sir W. Flinders Petrie in a recent address before the Society of Glass Technology said that in his opinion no glass was made in Egypt prior to about 1500 B. C. at which period, according to scriptural records, Assyrian workmen were being brought into Egypt, carrying with them glass vases of their own making. There is no evidence of the production of glass in Egypt until that time.

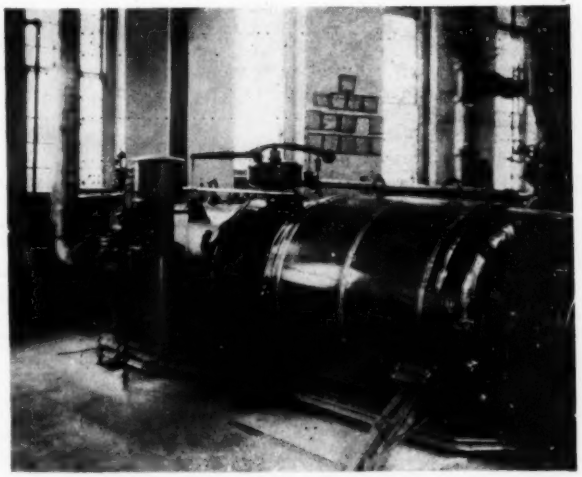
There is no question that the Assyrians were far ahead of the Egyptians up to this period in the matter of art and industry, and there is little difficulty in attributing to the former the glasswares which were imported into Egypt prior to 1500 B. C. Examples of glass have been found in Syria, in the Euphrates region, which can definitely be dated back to 2500 B. C.

Babylonia beads of glazed frit have been found to be "common" in a cemetery of the Third Dynasty of Ur (2450 B. C.) near Ur. Some of the glazes from Ashur are as old as the XIIth century B. C. Finally the dated glass vessel of Sargon's reign (end of VIIIth century B. C.) should be mentioned as the earliest dated Assyrian glass.

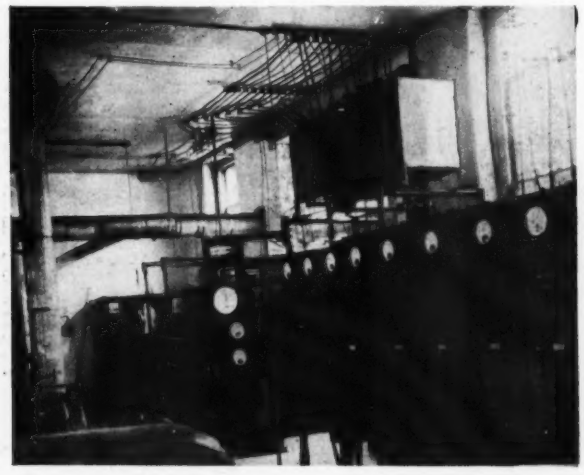
Electrification Effects Large Saving in Coal

By J. L. Bacon*

Following an investigation in 1920 of power house efficiencies of one turbine generator as against a number of small reciprocating engines, this company decided to install electric generating equipment and electrify the plant drive. Accordingly, a 300-kilowatt turbine generator was installed at the South Millville plant during the early part of 1921, together with motors to handle the load of 22 small reciprocating engines located in various parts of the plant. The engines abandoned ranged in size from 10 to 35 horsepower.



ONE OF THE TURBINE GENERATORS



THE SWITCHBOARD

Six months later a second unit was installed in order that one might be used as a spare. This was necessary because electric power is required at all times and there must be one unit in operation 24 hours a day and 365 days a year.

Our turbine installation saves us more than 2,000 tons of high grade coal (approximately 14,800 B.t.u. per pound) annually and, in addition, saves maintenance labor amounting to nearly half of one man's time on each eight-hour shift.

Our business is the manufacture of a line of druggists' and chemists' glassware. The electric motors are applied to driving fans (to supply the air needed in the glass blowing work), grinders and agitators, and the many machines

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in the machine shop. Electric power is, of course, also used for lighting.

Steam is generated in four hand-fired, fire tube boilers. This steam is used in the gas producers, in some of the air compressors and to drive the turbines. Two of the four boilers are rated at 150 horsepower and two at 125 horsepower. They operate at a pressure of 80 pounds.

The turbine generators are of General Electric manufacture. The turbines are form B machines of the four-stage type, rated 3,600 r.p.m., 80 pounds pressure and operated condensing. The cooling water from a nearby river is pumped through the surface condensers by a centrifugal pump driven by a 25-horsepower motor. After the cooling water passes through the condensers it is mixed with the condensate and from this mixture the boiler supply water is taken. The excess water flows back to the river.

The generators are direct connected, type ATB, rated 375 k-va., 480 volts with a power factor of 80 per cent.

In addition to being more efficient than the old engine-driven system, the turbine generator installation is much more reliable. With the engines there were frequent breakdowns and the maintenance and repair costs were considerably higher than they are now. Besides the reduction in repairs and consequent delays, the turbines require less lubricating oil and save space.

The cost of operating the present generating equipment is shown on the accompanying table. Depreciation is figured on the cost plus all installation expenses of the turbines, generators and exciters, condensing equipment and all switching apparatus. This rate for modern equipment of this type

SOME OF THE MOTOR LOAD IN MACHINE SHOPS

is approved by various public service commissions. Taxes are figured at $3.90 per $100 on 60 per cent of the cost. The insurance rate used in the calculations is $1.75 per $100 on 75 per cent of the cost.

During the four years that the generating equipment has been in operation the annual repair costs have been less than $50 but, in order to be on the conservative side, an estimated annual allowance of 1 per cent of the cost of the

(Continued on page 269)

* Allowing for interest earned by depreciation reserve.

Savings Effected by the Installation of the Turbo-Generator Units Compared with Engines

	Tons
Saving in coal—	
Former average daily coal consumption in power plant—3,095 tons ÷ 119 days	26.01
Present average daily coal consumption in power plant—2,434 tons ÷ 120 days	20.28
Net saving per day in coal	5.73
Annual coal saving—5.73 tons × 365 days × $5.40	$11,294.10
Saving in labor—	
Attendance labor for engines per day—24 man hours × 50c. per hour	$12.00
Present attendance labor required per day—12 man hours on turbines—12 × 50c. per hour. $6.00	
Man oiling motors—1¼ hours per day × 50c. per hour .63	
	6.63
Saving in labor per day	$5.37
Annual saving—$5.37 × 365 days	$1,960.05

Cost of Operating Two Turbine Generator Units

Depreciation (cost of equipment ÷ installation expenses)—	
Turbine generators—$25,265.00 × 5%	$1,263.25
Condensing equipment—$12,150.00 × 5%	607.50
Switchboard and switching equipment—$2,475.00 × 5%	123.75
*Average interest at 6% $-\frac{21}{20}\times\frac{\$39,890.00\times.06}{2}$	1,256.54
Taxes—$.390 per $100.00 on 60% of valuation	933.43
Insurance—$1.75 per $100.00 on 75% of valuation	523.56
Annual allowance for repairs and repair labor (estimated) 1%	398.90
Depreciation on pipe line—$5,100.00 × 10%	510.00
*Average interest at 6% $-\frac{11}{10}\times\frac{\$5,100.00\times.06}{2}$	168.30
Annual fixed costs	$5,785.23
Fixed costs per average day—$5,785.23 ÷ 365 days	$15.85
Average oil used—0.558 gallons per day × 50c. per gallon	.28
Steam for condensate pumps—270 lbs. per hr. × 24 hours × 45c. per 1,000 lbs	2.92
Power for condenser cooling water pumps—9 kw. × 24 hours × 3.27c. per kw. hr	7.06
Attendance labor—½ × 24 hours × 50c. per hour	6.00
Steam consumption of turbines (on basis of average load) 1,620 kw. hr. × 28.6 lbs. steam per kw. hr. × 45c. per 1,000 lbs	20.85
Total cost per 24 hour day	$52.96
Total cost per kw. hr. generated—$52.96 ÷ 1,620 kw. hr.	$.0327

Net Savings Effected by Turbine Installation

Annual coal saving		$11,294.10
Annual labor saving		1,960.05
Total		$13,254.15
Fixed costs on turbine installation		$5,785.23
Added fixed costs of engines over motors in plant—		
Depreciation—$20,000.00 × 5%	$1,000.00	
Average interest at 6%— $-\frac{21}{20}\times\frac{\$20,000.00\times.06}{2}$	630.00	
Repairs—3% × $20,000.00	600.00	
Taxes—3.90 per $100.00 × 60% × $20,000.00	468.00	
Insurance—$1.75 per $100.00 × 75% × $20,000.00	262.50	
Total		$2,960.50
Additional fixed costs on present installation		$2,824.73
Net annual saving		$10,429.42
Net annual return on the investment in generating equipment		23.2%

installation is included for repairs. The general maintenance labor is not covered by this 1 per cent, but is taken care of under the daily operating costs given.

Depreciation on the cost of installing the pipe line for the cooling water is figured at 10 per cent. No repair allowance is made because the main portion of this item was the digging expense and any small amount of maintenance would be covered by the 10 per cent depreciation.

The total of these items represents an annual fixed expense of $5,785.23, or an average daily fixed cost of but $15.85.

To the daily fixed expenses are added the daily operating expenses. The oil used per day is the average based on the annual oil consumption. Operating labor amounts to half of one man's time. The average steam consumption of the turbines was obtained from actual tests in which the condensation was weighed.

The total operating cost including fixed charges is $52.96 per day. On the basis of the average load, this is a unit cost of $.0327 per kilowatt-hour. This cost is high because the average load on the turbines, when taken over a year's time, is comparatively low, and the fixed costs and operating labor are a large percentage of the total power cost. These items would remain practically the same even though the load were double what it is now. Furthermore, the fixed expenses cover the spare unit as well as the one in use.

When the steam engines were in use, the average daily coal consumption in the power plant was 26.01 tons, whereas now the daily consumption (even with a small additional plant load) is but 20.28 tons. The net saving of 5.73 tons per day amounts in a year to $11,294.10 at an average cost of $5.40 per ton delivered inside the boiler house.

The labor with the engines amounted to 24 man-hours per day, whereas now the attendance labor amounts to but half of one man's time. Adding the time now required to oil the motors to the present labor cost of the turbines, and then subtracting this total from the former labor cost, there is a net saving of $5.37 per day, as shown on the accompanying table. In a year, this saving amounts to $1,960.05. The total saving in coal and labor amounts to $13,254.15 per average year.

The fixed costs on the engines formerly employed are, of course, greater than on the motor drives. These fixed expenses on an additional investment of $20,000 (engines compared with motors), amount to $2,960.50. In determining the fixed costs on this investment, the same rates were used for all items as on the turbines except on the repairs, where an allowance of 3 per cent was made as against 1 per cent for the turbines. Subtracting the additional fixed costs of the engines (compared with the motor installation), from the fixed costs on the turbine generators, the additional fixed costs on the present installation are $2,824.73. Subtracting this from the gross saving in labor and coal, there is a net saving of $10,429.42 per year, as shown on the table. This saving represents a net annual return on the investment in the turbine generators and auxiliary equipment of 23.2 per cent and pays for the entire installation in less than 4½ years from the time it began operations.

The Laboratory

Analysis of Zirconium Glasses

Of recent years a great deal of investigation has been devoted to the use of a number of the more or less rare elements in various industries, especially the glass and enamel, the refractories and the metallurgical industries. Some of these investigations have met with considerable success. One of the most interesting developments has been the use of zirconium in certain glasses, refractories and alloy steels.

Occurrence of Zirconium in Nature

Zirconium occurs mainly in two minerals, baddeleyite, zirconium oxide (ZrO_2), and zircon, zirconium silicate ($ZrSiO_2$). Most of the baddeleyite ore is found at Sao Paulo, Brazil, and on the island of Ceylon. In this country a deposit of zircon sand has been located at Pablo Beach, Florida. A remarkable American locality for zircon is near Green River, Henderson County, North Carolina, where it is found in considerable quantities. Although usually considered as one of the more uncommon elements it is quite widely distributed and is one of the common accessory constituents in all classes of igneous rocks, especially granite, syenite and diorite.

Use of Zirconium in Glass Manufacture

At the present time zirconium is being used to some extent in Europe in the manufacture of chemical glassware and to produce glass that can resist sudden changes in temperature without breakage. Venzel Horak of Czechoslovakia, in 1924, patented a glass which is claimed to have great elasticity, is a good conductor of heat and is resistant against variations in temperature. Its composition is as follows:[1]

	Per Cent
Sand	60-70
Boric acid	15-30
Potassium carbonate	1-2
Soda ash	3-6
Zirconia	1-3
Titanic acid	1-3

Zirconia is known to be used with success in the manufacture of bottle glass.

An investigation of the action of zirconium in glass has been made by Prof. W. E. S. Turner of Sheffield University, and by the Royal Testing Laboratory of Berlin-Lichterfelde. Unfortunately the investigators have reached conclusions which are diametrically opposed. In view of the results obtained in practice, which cannot be ignored, it appears that further consideration of the use of zirconium in glass making is in order.

[1] GLASS INDUSTRY. Vol. 5, No. 6, p. 104 (June, 1924).

The analytical methods of determination of zirconium in glass leave something to be desired in speed and accuracy. On account of the similarity of chemical behavior of zirconium, titanium, aluminum and iron, the separation of these elements, all of which may occur in glass at the same time, is somewhat complicated, and would be quite difficult but for the introduction of cupferron in analytical chemistry for which we are indebted to Baudisch.

Outline of Methods of Analysis

For the analysis of bottle glass containing zirconium, the following scheme is suggested:

Treat one or two grams of the powdered sample (depending on the amount of zirconium present) in a platinum dish with hydrofluoric and sulphuric acids and heat until the silica is completely volatilized. Heat on a sand bath to fumes of sulphuric acid, to eliminate all hydrofluoric acid. Allow to cool, add water and some hydrochloric acid, transfer to a beaker and heat until the salts have gone in solution. Add a few grams of ammonium chloride, make the solution slightly ammoniacal, using methyl red indicator, and allow the precipitate of the hydroxides of iron, aluminum, zirconium and titanium to settle for a short time. Heat to boiling and filter. Reserve the filtrate for the determinations of lime and magnesia.

The precipitate is dissolved in hot 1:1 hydrochloric acid and the solution collected in a beaker. Add about 0.75 grams of tartaric acid, make the solution ammoniacal and gas with hydrogen sulphide. This will precipitate all of the iron as sulphide, while aluminum, zirconium and titanium remain in solution. Filter, wash with dilute ammonium sulphide-ammonium chloride solution and determine the iron by one of the standard methods.

The filtrate is boiled for some minutes, and is then rendered 15 per cent acid to sulphuric acid. Hydrogen sulphide is expelled by boiling and the solution is filtered, if needed. Cool in running water to below 15° C. and add six per cent solution of cupferron, stirring vigorously to cause the formation of a flocculent precipitate. Addition of some paper pulp is helpful. An excess of the precipitant is indicated by the formation of a fine white precipitate which redissolves, instead of a curdy one which persists. Filter, after a short time, using a platinum cone with suction. Wash the precipitate with a five per cent sulphuric acid solution containing some cupferron. The precipitate contains the zirconium and titanium. The aluminum remains in solution.

Dry and ignite the paper and precipitate in a tared platinum crucible and weigh the mixed oxides of Zr and Ti. Fuse with potassium pyrosulphate, take up with ten per cent sulphuric acid and determine the titanium by the colorimetric hydrogen peroxide method. Deduct the weight of the TiO_2 from that of the combined oxides, which will give the weight of the ZrO_2.

FACTORS: $Ti \times 1.6652 = TiO_2$; $TiO_2 \times 0.6005 = Ti$

$Zr \times 1.3532 = ZrO_2$; $ZrO_2 \times 0.7390 = Zr$

The colorimetric method to determine titanium is only applicable to small amounts, such as would occur in glass as a result of the introduction of titanium as an impurity in the sand and alumina used. When the titanium is added in any appreciable amounts, such as in the Horak glass, the titanium obtained, as described above, should be reduced in a Jones reductor, containing ferric alum-phosphoric acid in the receiver, to titanium sesquioxide, and then be oxidized to titanium dioxide by titration with standard potassium permanganate solution.

To determine the aluminum in the filtrate from the zirconium and titanium the organic substances must first be destroyed, by addition of nitric acid and boiling, until fumes of sulphuric acid appear. While this eliminates the cupferron, it is not sufficient to destroy all of the tartaric acid. To accomplish this, small amounts of nitric acid should be added cautiously to the hot sulphuric acid. Care must be taken to prevent too much foaming of the carbonaceous matter, formed by the decomposition of tartaric acid. When the foaming stops and only the white fumes of sulphuric acid are visible the decomposition is completed. Add water, some hydrochloric acid, boil, filter, add ammonia to precipitate the aluminum and determine the latter in the usual manner.

Fifty Years of Glass-Making

By Alexander Silverman*

(Concluded from the October number)

Optical Glass

In 1878 Ernst Abbé made an appeal for research on optical glass and in 1881 attracted the attention of Otto Schott. Except for trials with borax and titanium oxide, only compounds of silicon, sodium, potassium, calcium, and lead had been employed in optical glass manufacture prior to that time. In Schott's experiments the effects of compounds of more than twenty-five additional elements were studied. Already in 1891 the Jena factory announced fifty glasses possessing new optical properties. The late war caught the United States napping in optical-glass manufacture, as in a number of other industries. Be it said to the credit of the Geophysical Laboratory and our government bureaus that with the cooperation of manufacturers the situation was soon remedied. We are now able to meet our needs and have added the porcelain pot and large-scale manufacturing methods—for example, melting in tank furnaces and rolling optical glass in plates. Castings up to 250 centimeters in diameter are made in Europe and we are still limited to about 30 centimeters, but the rest will come.

A number of special types of optical glass are now in demand. One of these contains cerium oxide, boric oxide, and ferrous or cobalt oxide, and is used to protect the eyes against ultra-violet and heat rays in high-temperature cutting and

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From *Industrial and Engineering Chemistry*, September, 1926.

welding. Modifications give us the various tinted lenses sold to protect the eyes out of doors. Another type in sheet form is so constituted as to let the actinic rays through, thus approximating transparent fused quartz. Silicon-free glasses are in the experimental stage, and in one instance germanium oxide has been substituted for the silica.

Chemical and Cooking Ware

Glass of low coefficient of expansion and high resistance to chemical corrosion was made in America in the years immediately following the birth of our Society. Many of us recall Nonsol. Then came the Jena glass of Schott, and with the war Pyrex, the work of Taylor and others at Corning. More recently the laboratory glass, with slight modification, has been blown and pressed into cooking ware and baking dishes in a number of plants, and it is now a staple article on the market. Not only are the dishes transparent, or nearly so, but the same may be said of panes in oven doors.

Heat-resisting glass may be colored, and is used for lantern globes and signal lenses to eliminate the danger of breaking in inclement weather when there is a hot light source on one side of the glass and snow or rain on the other.

Furnaces and Accessories

In the earlier days of glass-making raw materials were piled in any convenient place in the factory. Now they are stored in concrete bins, which insure greater uniformity as the contents are not exposed so freely. From these bins the materials go to modern scales, frequently automatic, then to mechanical mixers of the concrete type, and in window or bottle factories, by belt conveyor to the melting tanks.

Furnaces are now largely of the regenerative or recuperative type, fired by natural gas, producer gas, or oil. Tank furnaces for window-glass manufacture hold several thousand tons of glass and may melt three to four hundred tons per day. A recent invention suggests the use of small melting compartments which feed the finished glass into the larger tank, claiming facility in repairing the melting units, where most of the tank corrosion takes place. There is a further possibility that pot furnaces of the future will be of the small one- or two-pot type, because of the great variety of glasses now being manufactured and the consequent necessity for a variety of temperatures easily controlled, not only for the melting, but also for the subsequent working of the products. The old idea of using a standard batch and simply adding this, that, or the other coloring agent is fast disappearing, as many of the new coloring agents require special batch compositions.

Extensive studies on the composition of refractories are under way, and a better understanding of the function of raw materials and nature of the physical and chemical changes taking place during their use is in prospect. The successful casting of pots and other refractory units has been accomplished, accompanied by economy of time in manufacture and drying.

Pot-arch design has had considerable attention. The studied circulation of heat and the higher temperatures obtainable have effected economy through the more uniform heating of the pot with greater resistance to corrosion. Lehrs have already been mentioned. The muffle type is rapidly supplanting direct firing, and electrical annealing is only a question of cost of current.

Combustion studies and pyrometric control have played a big role in the economics of glass manufacture. The plant that pays no attention to its fuel, to the nature of furnace gases, to temperature, as a check on furnace and lehr operation, is a back number.

Calculations

Last, but not least, in this list of topics discussing developments of the past fifty years comes the subject of "calculations." Data are accumulating, slowly but surely, which enable technical men to anticipate possibilities in glass manufacture, so as to minimize the cost of experimentation and supplant the rule-of-thumb methods by more reliable ones.

It is now possible to study the physical properties of a glass and tell how it shall be annealed. The strain-finder, employing polarized light, tells the manufacturer whether the glass has been annealed properly. The study of two glasses will determine whether they may be worked together, or how they must be modified to accomplish this.

Trade secrets, which so strongly characterized the glass industry years ago, are things of the past. The chemist who has also had experience in the factory, can analyze practically any glass that is submitted to him, and reproduce it in short order.

The Trend of the Times

In the early days of glass-making a manufacturer had a tendency to make anything the customer wanted, from a vase to a window pane. Today specialization prevails, one manufacturer making window glass, another plate glass, a third table ware, a fourth bottles, and so on. The introduction of automatic or semi-automatic machinery has made this possible, or perhaps necessary.

In the past small plants sprang up wherever there seemed to be a prospect of cheap fuel. Today a more careful study is made of future prospects. Fifty years ago the glass industry centered chiefly about Pittsburgh, Central New Jersey, and New England. Today it is pretty well distributed, with a somewhat greater increase showing in the number of California factories.

Fifty years ago a midwestern plate-glass factory with over two thousand employees failed for lack of tariff protection. Today it is a function of a government commission to study the needs and afford protection. Not only are these studies important, but the economy effected by the industry itself, through consolidation, plays a part. One large company, which today has only six factories, at one time operated fifty-three; yet with its six plants it produces about three times as much window glass, and of a much better quality. The grouping of factories in various lines, instead of having a great many small plants compete, has succeeded in stabilizing industry. Today there are three very large producers of window glass, four of bottles and containers, and two of plate glass. Table-ware manufacture is still scattered in many small units because automatic and semi-automatic machinery has not been applied so largely in this branch of the glass industry. . . .

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Industrial Research Scores Another Triumph

An announcement of far reaching effect was made at the recent meeting of the American Refractories Institute, when Dr. Gordon S. Fulcher, of the Corning Glass Works, described how the problem of making tank blocks has been solved to a large degree by entirely new methods of manufacture.

Every producer of tank glass who has been confronted with the necessity of increasing output knows that there is no other way to obtain more glass of high quality than by the application of higher temperatures. This, however, produces such rapid corrosion of tank blocks that the life of the tank is shortened in consequence. It is clear that the limiting factor in production is determined by the rate of corrosion at the temperature required to melt good glass at high speed.

For years the increased capacity of modern automatic glass making machinery has been held in check by failure of the refractories to stand the wear and tear resulting from greater production. With the corrosion problem solved, it is no exaggeration to state that the glass industry is entering upon a new phase of expansion.

It is of interest to note that again the glass industry has learned from metallurgy to make a step forward. Already we owe to metallurgy the regenerative furnace, the gas producer and the development of pyrometric control of furnace operation. The electric furnace, improved and perfected through its use in the manufacture of ferro-alloys, now furnishes to the glass industry a method to obtain refractory materials, adapted to its special requirements.

Electrification Pays Large Returns

Elsewhere in this issue is a plain statement of the economies effected by the electrification of one of the oldest glass factories on this continent. Electrification of the glass industry pays large returns, because, with one exception,—the automobile industry—the electric light and power industry is the only one that has been able to reduce the price of its product since 1914, while other prices have gone up sixty-five per cent.

There are two sets of reasons for this fact: one financial and one technical. The financial reason lies in the combination of the numerous small power companies into a few huge holding corporations, making for centralized managerial control and giving access to large supplies of capital. Among the technical reasons are the building of enormous generating plants combined by superpower lines, the inclusion of hydro-electric plants and the connection with local generating stations into large reservoirs of power. Another technical reason is the perfection with which technical control of the generating plants is being carried on.

It is doubtful if there is another industry which exercises such complete and accurate control over its processes as does the electrical power industry. Where steam is the source of power, automatic electrical analysis of the gases of combustion is generally practised. It is certain that fuel consumption in the glass industry could be materially lessened

by adopting some of the methods, now in common use in what is probably the most efficiently managed industry in existence.

Pioneering Engineers

The National Foreign Trade Council has recently published an interesting contribution to the literature of American foreign trade, written by C. C. Martin, the well known foreign trade expert, entitled: "Can We Compete Abroad?" It gives an account of modern American achievement in foreign commerce and contains a number of highly entertaining stories, relating how success has been obtained by foreign traders in the face of what appeared to be insurmountable obstacles. Of especial interest to glass manufacturers is the description of the introduction of American glassmaking machinery in Europe. Indications of the serious concern to European glassmakers, caused by the invasion of their market by the American engineer-glassmaker, has been in evidence from notices appearing in the leading European technical papers, devoted to glass manufacturing.

Regarding the progress of the Libbey-Owens concern abroad, the author has this to say:

"Belgium is the classic land of glass manufacture, but it required the introduction of an American process, the Libbey-Owens, to give new life to the industry. In this process the glass is drawn by mechanical means from a pot connected with the furnace, in an endless sheet, bent over a roll into a horizontal position and passed through an oven, 200 feet in length, at the end of which it emerges, perfectly annealed, on to a cutting table ready to be cut into the required lengths. From the furnace to the cutting table the process is continuous and entirely mechanical, the skilled and highly paid labor of gathering, blowing and flattening, incident to the old-fashioned method of window-glass manufacture, being entirely eliminated. In the United States this process is owned by the Libbey-Owens Sheet Glass Company and the European market is being exploited by a controlled Belgian company, the Compagnie Internationale pour la Fabrication Mecanique du Verre. The latter concern is establishing plants throughout Europe. As in so many other instances, American invention and methods of production are revolutionizing manufacturing processes abroad."

Technical Consultation Service

THE GLASS INDUSTRY invites its readers to refer to this department any problems with which they may be confronted pertaining to raw materials, glass technology, laboratory and factory practice. While making no pretensions to the possession of unbounded knowledge or infallibility the GLASS INDUSTRY is ready to assist its readers to the best of its ability in solving their problems. Readers who can offer better suggestions than those printed are invited to submit them. All inquiries will be considered confidential.

Natural, Synthetic and Artificial Cryolite

QUESTION 102.—What is the difference in chemical composition between natural, synthetic and artificial cryolite?

ANSWER.—Cryolite is sodium aluminum fluoride, $3NaF.AlF_3$, containing about 60 per cent sodium fluoride and 40 per cent aluminum fluoride. Its chemical composition, theoretically, is as follows:

Sodium (Na.)	32.79%
Aluminum (Al.)	12.85%
Fluorine (F.)	54.36%

Synthetic cryolite, sold under various trade names resembles the natural product quite closely as regards chemical composition and is sometimes almost entirely free from iron. This is of great importance since the presence of only a small amount of iron will give to opaque glass a definite greenish tinge which is especially objectionable in illuminating glass ware. On account of the freedom of impurities, the synthetic product is at times preferred to the natural.

So-called artificial cryolite may either mean the same as synthetic cryolite, or it may indicate one of the various cryolite substitutes on the market. They are usually mixtures of feldspar or kaolin with fluorine compounds such as fluorspar or sodium fluosilicate. When using these compounds it is desirable to have a statement as to the chemical composition, as they often contain considerable amounts of soda ash and silica, which while harmless serve only to dilute the active constituents for which the material is bought. Some manufacturers consider it advisable to mix such materials at the plant, rather than buy them, sometimes at a fancy price, ready for use.

New Books

COMMERCE YEARBOOK, 1925. Compiled by the Bureau of Foreign and Domestic Commerce, Julius Klein, Director. Sold by the Superintendent of Documents, Government Printing Office, Washington, D. C. XX and 752 pages. Bound in cloth with numerous charts, maps and tables. Price $1.

CHEMICAL ENGINEERING CATALOG. Eleventh Edition, 8½ by 11½ inches. Over 1,200 pages. Chemical Catalog Company, Inc., New York. Published under the auspices and supervision of the American Institute of Chemical Engineers, American Chemical Society and American section of the Society of Chemical Industry. The catalog is listed at $2.00 for one year to certain classifications of men interested in chemicals and the chemical industries, $10.00 a year to others. The usual comprehensive classified index of equipment and materials manufacturers, and "first hand" sources occupying the front part of the book has, in this edition, been considerably enlarged and contains a list of nearly 2,000 manufacturers. A technical and scientific book section listing works on innumerable subjects of interest to technical men, and obtainable from the Chemical Catalog Company, Inc., at 19 East 24th street, New York, is also included. The remaining 800-odd pages of the catalog are devoted to catalogs and specifications of materials, supplies and equipment for the chemical industries. The classified index of manufacturers of chemicals, minerals, etc., and the announcements of the manufacturers of equipment and supplies contain a great deal of information regarding sources of supply that are not given in any of the general business directories, making the catalog of special value to concerns interested in chemical processes.

Refractories Institute's First Technologic Paper

"A Study of Tests for Refractories, with Special Reference to Spalling Tests," is the title of the first technologic paper issued by the American Refractories Institute. It relates some phases of the work done by Stuart M. Phelps, Industrial Fellow of the Mellon Institute of Industrial Research, Pittsburgh, Pa.

The paper, now available for distribution, was read before the annual meeting of the American Refractories Institute, held in Philadelphia last spring.

The bulletin contains a detailed description of load tests, conducted with a number of fire bricks obtained from manufacturers whose products were thought to be representative of various districts or types of brick.

Spalling tests were carried out in a way closely simulating conditions as they occur in practice. For this purpose a special furnace has been constructed, which makes possible the heating of a number of fire bricks to a desired temperature for a definite time and then exposing them alternately to a cold air blast and reheating, at regular intervals.

Although a great deal more work will be necessary to obtain sufficient information to formulate a practical tests procedure, the results at hand are very promising.

Copies of this paper may be obtained from the Secretary's office, Oliver Building, Pittsburgh, Pa., a charge of 50 cents per copy being made to cover the cost of printing.

The American Patent System*

By an English Patent Attorney

We have previously noted some outstanding differences between the American and European patent systems, pointing out the precautions that should be observed by American citizens who seek to obtain patents under the European systems[1].

We will now consider the matter further from the point of view of the European national who intends to obtain patent rights in the United States of America.

It has already been noted that under the American Patent Law the home inventor is allowed two years within which to experiment and perfect his invention, and even go so far as to try it out in the open market, before filing his application for patent protection.

As a corollary to this, it follows that in the case of two or more separately-made but conflicting inventions for the same or similar subject-matter, the rights ultimately attach to the man who first made the invention, and not to him who first files the patent application. Thus in interference proceedings evidence of the date of the conception of the invention becomes of paramount importance and it is common in such proceedings to produce notebooks, orders for fittings, castings or parts, or oral evidence of friends or acquaintances to whom the idea was mentioned, in establishing the earliest date at which the invention had taken shape in the inventor's mind.

As regards foreigners, however, the patent system includes a proviso that the American patent must be filed within twelve months of the filing date of any prior patent application filed in any other foreign country. There is one weakness in this rule which will be noted later, but it has an important corollary in that the earliest date at which the foreign inventor can be credited with having been in possession of the invention is subject to a limiting period of not more than twelve months prior to the date at which the American application is filed.

Thus at the very threshold of his attempt to obtain a patent monopoly under the American Law, the foreign inventor immediately finds himself under a disadvantage.

The weakness in the rule to which we have referred is important as providing a loophole for obtaining an American patent when the period of twelve months has through unavoidable circumstances been exceeded; but the loophole is in any case of very limited possibilities, and its use is fraught with considerable difficulty and risk.

In the framing of the section governing the rule above noted, it is set out that the United States application must be made within twelve months of any prior foreign *patent*. If, however, the prior foreign application has not matured into its grant, the rule is not violated; and it is therefore possible to secure a valid American patent, even though a foreign application exists of more than twelve months priority, provided that the American patent *issues* first, the grant of the foreign application being delayed at the request of the applicant until after the grant of the American patent. There is, however, a limit to the period for which the foreign patent can be delayed (a Belgian application, for example, is usually limited to about four months), and in order to take advantage of the loophole it is usually necessary to have the American application made "special," that is to say, taken out of its turn and treated as urgent by the American Examiners, for which purpose the United States Patent Office requires the production of a certificate from an official of the foreign Patent Office setting forth the latest date to which the grant of the foreign patent can be postponed. Even then it is never certain that the examination proceedings of the American application can be expedited sufficiently to ensure that the American grant occurs first.

Thus in all cases where the European inventor, having applied for a European patent, turns his thoughts towards obtaining an American patent, he should do his utmost to arrive at a final decision, and to raise the necessary funds, in time for the American application to be filed in the Patent Office in Washington within twelve months of the date of filing the first European application; and in this connection it should be noted that for safety a week should be allowed between the arrival of the mail boat at New York and the critical date on which the papers require to be filed at Washington.

In general comparison between the effect and liabilities attaching to an American patent as compared with those of a European patent, the following principal points of difference are to be noted:—

(1) The American patent remains in force for seventeen years from the date of its grant without the payment of any renewal taxes whatsoever.

(2) There are at present no provisions in the American law requiring a patentee either to have his invention manufactured in the United States by American labor, or to put his invention at the full disposal of American citizens by supplying it to the American market in adequate quantities.

It has been strongly argued on behalf of the United States that in these respects the American patent system is superior to the European patent systems, and that the European inventor seeking the protection of the American Patent Office is given greater benefits than an American seeking protection under the European patent systems.

It is true that in most European countries a patent is required within three or four years of the date of its grant to be "worked" within the country so as to employ the labor of that country in its manufacture, and also so as to supply to the market of that country quantities sufficient to satisfy the demand for the use of the patented article. This accords with the theory that monopolies generally are repugnant, and the patent monopoly is only tolerated as a special exception to the general prohibition inasmuch as it encourages the introduction and development of new industries in the country in which it is granted.

Further, the provision militates against the suppresion of patents, for example, the purchase by a big corporation of a patent enabling an article sold by the corporation to be made and sold more cheaply or superseded by a better article, the improvement covered by the patent so purchased never being actually manufactured, but the patent being used to block all attempts by others to come into the market. Patents not put into use owing to the commercial incompetence of their owners may also be cited as suppressed patents, which may nevertheless form a heavy incubus on the energies and enterprise of later competent and more advanced inventors.

The "working" and tax provisions tend to eradicate all such suppressed patents from the European patent systems, with the result that the inventor who has not only made a good invention but is in a position to manufacture it in large quantities has much more freedom to carry out his commercial plans in the European countries than in America.

In *Economics of our Patent System*, by Floyd L. Vaughan (McMillan, New York, 1925), the whole question of suppressed patents in the United States is very extensively analysed, and the writer takes the view that the existence of suppressed patents is an obstacle to technical development and a burden on industry.

At a recent meeting of the International Convention at The Hague, strong attempts were made to persuade all the European countries to standardize their "working" provisions to one general form whereby the penalty for "non-working" or non-supplying the market would not mean the avoidance of the patent, but would merely entitle any person who was willing to work the patent and supply the market to obtain from the Patent Authorities a compulsory license under the patent that was not being worked, the licensee however undertaking the liability to pay to the patentee a reasonable royalty having regard to the nature and merit of the invention, and also to the enterprise of the licensee in putting up the necessary capital and turning his energies to creating a new supply and a new market.

In the United Kingdom this position of affairs practically holds already, and it is submitted that this penalty for non-working is not onerous on the patentee and is in no sense a denial of the monopoly rights granted to him. On the other hand it works beneficially for the development of industry and the ready production of new inventions and improved articles generally for the benefit of the country at large.

In further moderation of the penalties imposed by the working provisions, it is usually considered that the penalty cannot be exacted if the patentee has done his utmost to comply with the provisions. Thus if the patentee has extensively advertised

Anglo-American Trade, American Chamber of Commerce in London.
[1] GLASS INDUSTRY, Vol. 6, No. 9, p. 199, (September, 1925).

the rights of his patent for sale or license but has failed to get any home manufacturers to take the rights up, he is deemed to have done his best to comply with the law, and to have a satisfactory answer to any person seeking to put it in motion against him. This precaution is commonly taken by patentees, the cost of putting advertisements in suitable trade papers or writing direct letters to the principal firms likely to be interested being usually inconsiderable.

A further point to be noted in connection with the United States is that litigation is much more frequent than in Europe and many times more expensive. Under the American system of combination claims, the tendency is to have a large number of claims in each patent which may relate to widely different aspects of the invention, or may differ from each other by the finest distinctions which after grant are hardly discernible. Thus claims are multiplied excessively and any one claim in a patent may form the basis of a patent suit.

In Europe, generally speaking, it is necessary to have one broad underlying idea in an invention and this may be covered over many alternative manifestation by means of a single claim.

In the writer's opinion it is undoubted that a more sound opinion can usually be formed as to the validity and/or infringement of a European patent than can be formed with respect to an American patent.

The consequence of this is that litigation in the United States is much more uncertain as to its ultimate result than in Europe, and in addition to the above, the organization of the judicial system in the United States imposes further heavy expenses on the patent litigant besides which European litigation can be considered as comparatively cheap. Mr. Vaughan gives the opinion that 10 per cent. of the time of the United States Courts is devoted to patent litigation.

American Engineers May Visit Japan

A movement is under way among the leaders of several engineering societies, including civil, mechanical, electrical, mining, metallurgical and marine engineers, to hold a conference in Japan in the fall of 1929 with the idea of investigating the marvelous advancement and achievements of engineering in that country. The Japanese congress has passed a bill providing a subsidy, the Prime Minister gave a dinner to prominent industrial people in the interests of the project and the Japanese government has expressed its desire to co-operate. An invitation is expected by the American interests involved from Dr. M. Kamo, president of the Japanese Society of Mechanical Engineers and head of the Department of Mechanical Engineering at the University of Tokio. All interested persons on both sides of the Pacific are enthusiastic over the plan.

Calcining of Small Limestone

In theory the calcination of small limestone seems to be very simple. It is only necessary to heat the stone to a point where calcium carbonate, and any magnesium carbonate present, will dissociate into calcium oxide and magnesium oxide, with an evolution of carbon dioxide, and to maintain this temperature until the reaction is complete, leaving lime. The temperatures required are not excessive. Many limestones will begin to break down apparently when heated to 600°C. As the temperature is increased the rate of reaction is greatly increased. The temperature in the average lime kiln will generally vary between 1,050° and 1,250°C, depending on the chemical composition and physical properties of the stone and the type of fuel employed. Metallurgically such temperatures are neither very high nor difficult to obtain.

In actual practice, however, the calcination of small stone presents many difficulties. The introduction of small stone in any type of ordinary shaft kiln blocks the draft so that continued operation is impossible. The carbon dioxide evolved from the stone and from the combustion of the fuel must be continuously removed, or a partial pressure will develop in the kiln which will prevent further reaction. To be successful any device utilized for the calcination of small stone must handle the material in commercial tonnages, and produce lime with a fuel consumption comparable to average kiln operation.

A new method for the manufacture of lime from small stone by the use of a sintering machine is described by W. M. Myers in Serial 2762, copies of which may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

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5. STAINLESS STEEL

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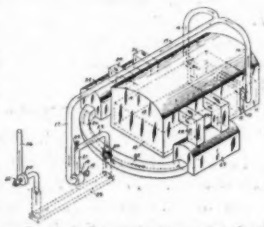
Recent Patents

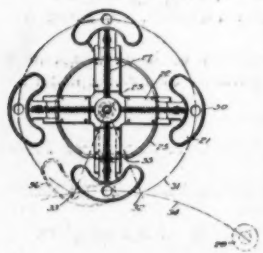
NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

FURNACE. U. S. 1,600,484. Sept. 21, 1926. Michael J. Owens, deceased, by Hazel O. Beesch, James C. Blair and John H. McNerney, administrators, assignors to the Owens Bottle Company. Filed 9/20/24. A furnace and a circulating system through which air for combustion is circulated, said system comprising a conduit leading from a source of fresh air supply at the hollow bridge wall and communicating with the interior of the furnace, a forced draft blower located in said conduit and operable to draw fresh air therethrough and force it into the furnace, a conduit leading from the furnace for carrying off the spent gases of combustion, a chimney with which said last mentioned conduit communicates, and an induced draft blower located within said last mentioned conduit and operable to draw the gases from the furnace and force them into the chimney. A similar system may be applied to recuperative furnaces.

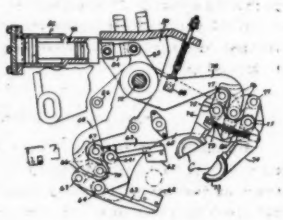


MEANS FOR TRANSFERRING AND GUIDING GLASS INTO MOLDS. U. S. 1,600,488. Sept. 21, 1926. John F. Rule, Toledo, O., assignor to the Owens Bottle Company. Filed 4/29/18. In a continuously rotating machine the molds are in charging position only for an instant as they pass the charging point so that it is difficult or impossible to drop the glass into the mold, unless some special provision is made for guiding the glass. This invention comprises a series of guides moving continuously in a horizontal circular or closed path, each guide being in the form of a funnel with its upper end or mouth elongated in the direction of its movement. As each mold approaches the charging station, one of said funnels or guides is brought into position over the mold and in register therewith to direct the charge of glass into the mold through a consideration range of movement of the molds.

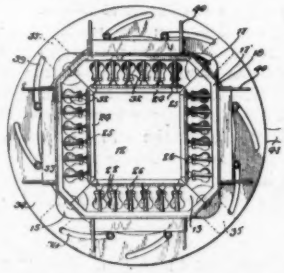


APPARATUS FOR THE MANUFACTURE OF ARTICLES IN SILICA GLASS. U. S. 1,601,523. Sept. 28, 1926. Henri George, Paris, France, assignor to Societe Anonyme Quartz & Silice. Filed 7/15/24 and in France, 11/2/23. Apparatus for the manufacture of articles in silica glass which allows of melting the charge in a crucible made of refractory and conducting material, preferably of graphite or amorphous carbon, by high frequency induction, until the mass is obtained in a pasty state, allowing its expulsion from the crucible, either by drawing or in a block with a view to a further fashioning in the press or by any other suitable mechanical treatment.

CUTTING APPARATUS FOR GLASS FEEDERS. U. S. 1,603,196. Oct. 12, 1926. Albert N. Cramer, Toledo, O., assignor to the Owens Bottle Co. Filed 8/6/20. Cutting mechanism periodically severing the glass, comprising shear blades, levers carrying said blades, a toggle connecting said levers, a pivoted support on which said levers are mounted, means to oscillate said support about its pivot and thereby swing said levers and toggle bodily into and out of a position in operative relation to the flowing glass, a lever arm fulcrumed on said pivot and connected to said toggle, and means to swing said arm and thereby actuate the toggle when in said position and thereby actuate the shear blades.

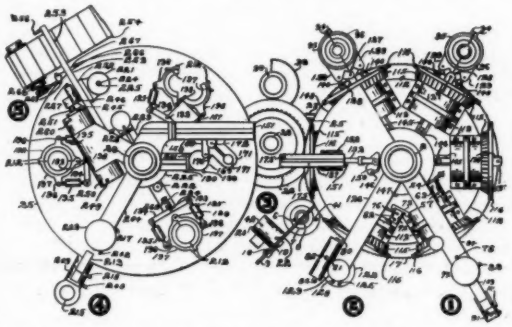


GLASS MOLD. U. S. 1,602,012. Oct. 5, 1926. Shay W. Gooch and William Kenton Yonge, Irwin, Pa. Filed 2/3/26. To provide a mold for producing large quantities of glass knobs connected to a suitable boxing or support to facilitate polishing, finishing, and the like. When the molding operation is begun, the pins are in their extended position as shown. The glass flows around the pins to form central openings in the knobs, and when the glass has cooled the cam ring is turned, drawing the draw bar 33 away from the sections by the action of the cam slots 39 on rollers, thereby withdrawing the pins from the knobs.



FLUX FOR ENAMEL, GLASS AND CERAMIC MATERIALS. U. S. 1,601,231. Sept. 28, 1926. Henry Blumenberg, Jr., Moapa, Nev., assignor to Stockholders Syndicate, Los Angeles, Cal. Filed 10/13/24. A flux for enamel composition for metal surfaces and glass and ceramic compositions, to produce compositions which after fusion have a greater brilliancy and elasticity than compositions made with sodium borate compounds. Boron trioxide possesses weak basic properties and combines with the stronger acids to form salts. If phosphoric acid is mixed with boric acid a white amorphous mass of boron phosphate is formed, in accordance with the following equation: $2B(OH)_3 + 2H_3PO_4 = B_2O_3.P_2O_5 + 6H_2O$. The inventor uses boron phosphate as an ingredient to the amount of 30% to replace the boron trioxide.

GLASS-FORMING APPARATUS. U. S. 1,602,926. Oct. 12, 1926. Frank O'Neill, Toledo, O. Filed 8/19/18. Glass-forming apparatus embodying a pair of columns, a blank carrier on said first column, a blow carrier on said second column, common driving means for both carriers simultaneously providing a station of rest therebetween as a transfer station, one of said columns

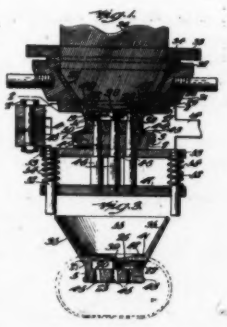


having its carrier provided with an annular series of mold mountings, a pair of mold sections pivotally connected to each of said mountings, control means for each pair of said sections, a cam fixed with said column and coacting through said control means as independently coacting therewith to hold the mold sections closed in certain angular positions of the carrier away from said transfer station of rest, and a piston and cylinder device including a rockable member movable relatively to said cam and coacting with a control means as at said station of rest for opening the mold section pair as at said station of rest.

METHOD AND APPARATUS FOR PRODUCING PLATE GLASS. U. S. 1,603,598. Oct. 19, 1926. James G. Haworth, Rossford, O., assignor to The Edward Ford Plate Glass Co. Filed 6/23/26. In combination, a plate glass casting table, means for progressively flattening a batch of glass on the table, and a member movable over a portion of the table and the initially formed end portion of the glass plate for retarding the cooling of such portion of the plate.

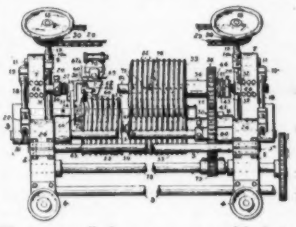
METHOD OF MOLDING GLASS AND APPARATUS THEREFOR. U. S. 1,603,025. Oct. 12, 1926. Ira M. Clarke, New Martinsville, W. Va., assignor to New Martinsville Glass Mfg. Co. Filed 6/7/26. The method of molding a bowl having inwardly over-hanging walls and an upwardly projecting central flower supporting member formed integral with the bottom wall, applying heat to the wall of said blank thereby plasticizing the same and lastly reversing the wall while in a plastic condition so as to cause said wall to surround said hollow cylindrical member.

A joint mold mounted upon base plate, core sections extending inwardly to form a central hollow chamber.



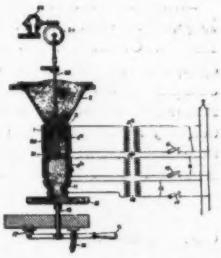
PROCESS AND APPARATUS FOR PRODUCTION CRACKLED GLASSWARE. U. S. 1,603,552. Oct. 19, 1926. David L. Middendorf, Columbus, O., assignor to The Federal Glass Co. Filed 2/4/26. The method of manufacturing and apparatus for producing crackled glassware comprising a blank mold having a metallic forming surface, means for spraying the forming surface of said mold with atomized water to produce a crackled exterior surface on the blank to be formed therein, means for forming a glass blank in said mold, a blow mold and means for blowing a blank positioned therein.

MACHINE FOR MANUFACTURING MARBLES AND SIMILAR ARTICLES. U. S. 1,601,699. Sept. 28, 1926. William J. Miller, Swissvale, Pa., assignor to Victor J. Greene. Filed 12/12/24. The sheared-off gob drops into and is carried along the groove in the roll 50 to its forming position where it contacts with both rolls. The lower roll rotates on its upper side toward the gob and the upper roll 33 rotates on its front side up away from the gob. The rolls rotating in the same direction tend to rotate the gob. "Turn-over" lugs are provided to engage the gob and assist it to rotate. The sphere is pushed laterally as well as rotated, whereby there is a tendency of the glass to become elongated in one direction. By slightly reciprocating one of the rolls the glass will pass from one direction of inclination to different positions as the roll 33 is reciprocated from point to point, whereby the tendency of the glass to prolate distortion is corrected and a truly spherical shape is obtained. In the case of small gobs the tendency to prolate is accentuated.



APPARATUS FOR CLEANING PLATE-GLASS POLISHING RUNNERS. U. S. 1,603,949. Oct. 19, 1926. Herman S. Heichert, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 3/23/23. In combination in apparatus for polishing plate-glass, a series of polishing machines, each having a rotatable frame provided with a set of polishing runners, means for carrying the glass to be polished beneath the runners of the series of machines, means for applying water to the machines to wash out the polishing material from the runners, fixed supporting means along the line of travel of the means carrying the glass on each side thereof, and shields between the machines extending across the glass to prevent the water employed in washing one machine from passing to the next machine, said shields being mounted upon said supporting means for vertical movement so that they may be moved out of contact with the glass when the washing operation is not in progress.

METHOD AND APPARATUS FOR MAKING GLASS. U. S. 1,603,221. Oct. 12, 1926. Elihu Thomson, Swampscott, Mass., assignor to General Electric Co. Filed 1/25/24. An apparatus for producing optical glass which consists in a vertical tubular container having openings at opposite ends, said container consisting of a noble metal, means for electrically heating said container, a feeding hopper communicating with its upper opening, means for agitating a charge in said container, a charge-receiving table and means for moving table from a position closing said lower opening, and a lower position, uncovering said opening to permit a charge to collect upon said table.

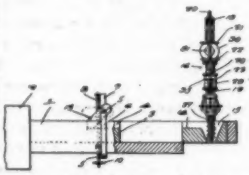


APPARATUS FOR FEEDING MOLTEN GLASS. U. S. 1,603,862. Oct. 19, 1926. Karl E. Peiler, Hartford, Conn., assignor to Hartford-Empire Co. Filed 12/8/22. In apparatus for segregating mold charges from a body of molten glass, the combination with a container for the glass provided with a discharge outlet, of a member having an internal flow passage into and through which the glass can flow by gravity to the outlet, and means for reciprocating said member to periodically accelerate or retard the gravitational flow to the outlet.

APPARATUS FOR MAKING SHEET GLASS. U. S. 1,603,946. Oct. 19, 1926. Frederick Gelstharp, Tarentum, Pa., assignor to Pittsburgh Plate Glass Co. Filed 5/7/23. In apparatus for making sheet glass continuously in a sheet or ribbon, the combination with a tank for molten glass, of sheet forming rolls at the outlet

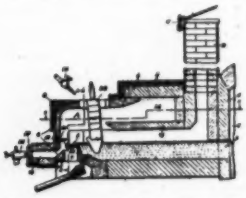
with their pass under head pressure of the tank arranged to control the rate of flow of the glass from said outlet and spaced apart a distance greater than the thickness of the finished sheet, and a second pair of rolls in advance of the first pair spaced apart a less distance than such first pair and serving to reduce the thickness of the sheet or ribbon.

APPARATUS FOR MAKING GLASSWARE. U. S. 1,603,479. Oct. 19, 1926. John J. Lentz, Butler, Pa. Filed 7/22/25. In an apparatus of the class described, means for regulating the flow of glass comprising a frame, a vertical shaft journaled for rotation in bearings on said frame, upper and lower friction driving discs carried by said shaft, a feed screw connected to the lower end of the shaft, and an adjustably mounted motor disposed in close proximity to said discs, there being a friction driving disc on the shaft of said motor co-operable with either one of the first named discs.



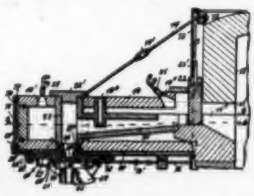
APPARATUS FOR CLEANING PLATE-GLASS POLISHING RUNNERS. U. S. 1,603,950. Oct. 19, 1926. Herman S. Heichert, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 3/23/23. Apparatus for use in cleaning a set of the vertically movable runners of a series of plate-glass polishing machines mounted above means for carrying the glass therebeneath, comprising a washing pan adapted to receive a set of said runners and mounted for movement longitudinally of the series of polishing machines intermediate the means for carrying the glass and the runners when the runners are raised.

APPARATUS FOR CONDITIONING MOLTEN GLASS. U. S. 1,603,974. Oct. 19, 1926. Vergil Mulholland and Karl E. Peiler, West Hartford, Conn. Filed 10/16/19. Glass conditioning apparatus, including a container for molten glass, a firing space, a baffle between said container and said space for directing heated gases over the surface of the glass in said container, a stack in communication with the container, and means operable in conjunction with the stack for controlling the admission of gases from the firing space into the container.



METHOD AND APPARATUS FOR DELIVERING VISCOUS GLASS. U. S. 1,604,000. Oct. 19, 1926. Oliver M. Tucker and William A. Reeves, Columbus, O., assignors to Hartford-Empire Co. Filed 8/12/18. A spout for delivering viscous glass from a furnace comprising a body portion with a delivery aperture therein, and a removable cover block closing the top of the spout adjacent the delivery aperture, said block having a port therein which is adapted to direct temperature modifying fluid forwardly and downwardly into said spout and to the glass adjacent to said delivery aperture.

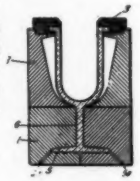
DEVICE FOR DISCHARGING MOLTEN MATERIAL. U. S. 1,603,994. Oct. 19, 1926. Merton A. Steelman, Vineland, N. J. Deceased, assignor by Administratrix to Hartford-Empire Co. Filed 6/6/16. Renewed 10/29/24. In a device for discharging molten material, a furnace provided with an opening for the exit of said molten material, a casing provided with an upright discharge chamber, means for supplying material to said chamber between its top and its bottom, a nozzle at the bottom of said chamber, and a removable cover, located in line with said nozzle, for normally closing the upper end of said chamber.



PROCESS FOR MAKING MIRRORS OR REFLECTORS. U. S. 1,603,951. Oct. 19, 1926. Halbert K. Hitchcock, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 11/17/23. The process of electroplating a reflector which consists in silvering the back and edge of a glass plate, depositing a band of metal upon said edge by electrolysis, and then depositing a metal coating by electrolysis on said back and extending over said band.

METHOD OF MANUFACTURING STEMMED GLASSWARE. U. S. 1,603,524. George S. Dunbar, Columbus, O., assignor to the Federal Glass Co. Filed 9/29/24. The method of manufacturing stemmed glassware which comprises depositing a charge of glass in a mold, moving an implement into the mold to form a blow blank, the same implement forming a stem and base integral with the blow blank from the same mass of glass and subsequently blowing the blank.

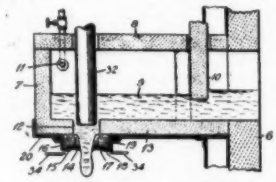
The specifications include a number of detailed claims.



PLUNGER STOP FOR GLASS PRESSES. U. S. 1,603,979. Oct. 10, 1926. Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Co. Filed 12/21/20. In a glass shaping machine, the combination with glass pressing elements including a mold, of actuating means for moving one of said elements relative to the other to press glass in said mold, and means controlled by abnormal adhesion of glass to said pressing means for discontinuing the operation of said actuating means.

PROCESS OF MAKING SHEET GLASS. U. S. 1,603,989. Oct. 19, 1926. Lee Showers, Charleroi, Pa., assignor to Pittsburgh Plate Glass Co. Filed 1/18/26. A process of making a glass sheet, which consists in rolling a body of molten glass laterally into a sheet at a relatively high rate of speed, carrying the sheet thus formed ahead on constantly shifting separated lines of transverse support, and then decreasing the speed of forward movement of the sheet and exposing it to a progressively decreasing temperature to anneal it.

APPARATUS FOR DISCHARGING MOLTEN GLASS. U. S. 1,600,962. Sept. 21, 1926 Karl E. Peiler, West Hartford, Conn., Assignor to Hartford-Empire Co. Filed 5/5/21. The object is to provide heat insulating means surrounding the discharge outlet, which reduces the heat loss of the discharging glass to the walls and edges of the outlet, and minimizes congealing immediately above the outlet. Another object is to provide such an outlet in the form of a removable spout or nozzle which may be readily replaced and easily insulated.



Industrial Publications

The Polariscope. Industrial Apparatus & Instrument Company, 239 Springfield avenue, Newark, N. J. A folder describing their instrument for determining the location of strains in glass.

The Artistic Lighting Equipment Association Incorporated, formerly known as the National Council of Lighting Fixture Manufacturers, has issued from their Cleveland, Ohio, headquarters a 64-page booklet describing the association's organization and activities and the benefit of constructive co-operation, and giving the by-laws, code of ethics and fair trade practice adopted by the association. A list of the members of the association is also given.

Centrifugal Air Compressors. A 4-page folder issued by the General Electric Company, Schenectady, N. Y., giving data on single stage centrifugal air compressors, including operating characteristics shown in curves, ratings, etc. This type of compressor or blower was introduced twenty years ago by the General Electric Company. It has been successfully applied in many different classes of service and is well adapted to glass blowing purposes, gas or oil burners on furnaces, tanks and lehrs, gas producers, factory ventilation, wind systems, and for cooling glass molds, rolls, pots, etc.; also for sand blasting.

The Glass World and What It Is Doing

News of the Industry

American Window Glass Annual Report

At the annual meeting on October 19 of the stockholders of the American Window Glass Company, all the directors were re-elected.

The annual report of the board of directors for the year ending August 27, 1926, was submitted and informed the stockholders that during the past year the company produced approximately the same amount of glass as during the preceding year, but the percentage of high quality glass was very much greater. The good condition of the company's plants may be illustrated by Factory No. 2, Jeannette, Pa., where the furnace, last May, was shut down for cold repairs. It had been in operation for five years and eight months except for periods during which hot repairs were made. This was the longest run ever known for a window glass furnace. This was the first of the modern style 12 machine furnace built by the company.

In general during the year improved methods of operation reduced production costs below those of the preceding year.

Group life insurance for the employes who desired to participate was taken out, part of the premium being paid by the employer and the remainder by the employes, nearly all of whom took advantage of the opportunity.

No very extensive alterations or improvements involving large expense were made at any of the factories during the year.

The installation of ten Fourcault type sheet drawing machines on No. 2 furnace at the Belle Vernon, Pa., factory was authorized. Nine of them will be used in the ordinary manner, while the tenth machine will demonstrate an improvement on the Fourcault method, in accordance with a patent recently taken out for the company. Eleven different companies in the United States have made commercial installations of some form of sheet drawing, seven using the Fourcault method which is also in operation in many foreign countries.

The directors reported that from the standpoint of quality the results obtained by the Fourcault process are not satisfactory and far from equalling those obtained by the company with their cylinder process. They stated that the Fourcault process produces a much larger percentage of "off-quality" glass and too small a percentage of better qualities in the proper size to meet the average requirements of the trade in this country. From the standpoint of quantity production the results of many of the Fourcault operations in this country have been quite satisfactory. Notwithstanding deficiencies in the Fourcault process the directors think they should keep pace with developments by trying it out and endeavoring to improve it.

The report called attention to the large increase in the amount of window glass imported into the United States during the preceding year, amounting to about 45 per cent, figured on the weight of the glass. This is the largest total of imports, figured in boxes, in the history of the country and amounted to about 10 per cent of the country's annual average consumption. Much of the imported glass was of inferior quality. An idea of the competition met with by American manufacturers from abroad may be had by comparing the rates paid for common labor in window glass factories in both countries. Here the minimum rate is 40 cents per hour for a ten-hour day. In Belgium, for male common labor they pay 20 francs per day of 8 hours. At the prevailing rate of exchange this figures 56 cents per day or 7 cents per hour in United States money, compared with our 40 cents per hour. Considerable female labor is employed in Belgium which is paid much less than male labor.

An advertising campaign, designed to increase the use of high quality window glass, has been authorized and is now under way.

The financial statement to the stockholders for the year ending August 27, 1926, shows net profit from operation of $1,344,822, other income, $751,954; total, $2,096,771. After deducting from income $67,530 reserved for taxes, $1,463,469 for royalties and $145.065 for other charges, the profit for year was $420,710. After deductions for dividends and capital stock amounting to $279,650, there was a surplus on August 27, 1926, of $10,845,438.

Polished Plate Glass Production

Production of polished plate glass in the United States still continues to exceed that of 1925, according to P. A. Hughes, secretary of the Plate Glass Manufacturers of America, who reports that the production for September, 1926, was 11,431,282 square feet as compared with 10,296,734 square feet for September, 1925. This was also an increase of 157,278 square feet over the August, 1926, production which amounted to 11,274,084 square feet.

The production for the third quarter of 1926 amounted to 33,453,498 square feet and shows a considerable gain over the same period of 1925 which amounted to 30,553,176 square feet. The nine months production, ending September, 1926, amounting to 100,622,477 square feet, is an increase of 13,517,341 square feet over that of the first nine months of 1925, which was 87,115,136 square feet, and equalled approximately 86 per cent of the total production for the year 1925, amounting to 117,224,298 square feet.

It is apparent from the above figures that if the present high rate of production is maintained throughout the fourth quarter of 1926, the total production for this year will, as predicted earlier in the year, amount to nearly 135,000,000 square feet.

In view of the fact that a large increase was made in production capacity by putting into operation the second unit of the Pittsburgh Plate Glass Company's continuous process, the increase in the country's total production so far this year has been a disappointment to some enthusiasts, who predicted a production considerably higher than 135,000,000 square feet. Failure to make such a high record is blamed on large importations of foreign plate glass which during the first six months of 1926 amounted to 12,673,268 square feet, an increase of about 4,500,000 square feet over the same period of 1925.

On the subject of imports Mr. Hughes recently said:

"The plate glass industry, in the United States has kept pace with the growth in demand for the product. The plants in this country, now in operation, can more than supply the domestic requirements, but with our own production at a high rate and heavy shipments of foreign plate glass coming in, the supply exceeds the demand.

"Part of the domestic production is going into the manufacturer's warehouses instead of going, as it should, into the warehouses of the distributors, some of which are well filled with foreign glass. The situation could easily grow worse and become very embarrassing to the American manufacturers and the well-being of the industry in the United States."

American Refractories Institute Fall Meeting

The regular fall meeting of the American Refractories Institute was held at the University Club, Pittsburgh, on Thursday, October 21. The first announcement to be made of the development and perfecting of a new refractory, particularly adapted for glass tank blocks, by the Corning Glass Works of Corning, N. Y., which development is described at length elsewhere in this issue, was made at the meeting by Dr. Gordon S. Fulcher, of the Corning company.

R. F. Geller, of the Bureau of Standards, described the "Value of Laboratory Tests of Refractories." A paper was also presented by Samuel J. McDowell, of the Bureau of Standards, Columbus, O., on "Laboratory Study of Slag Erosion."

Stuart M. Phelps, Director of Research and Tests, Refractories Fellowship, Mellon Institute, Pittsburgh, and H. F. Roberts, also of Mellon Institute, delivered a paper on the "Variation of Refractories" and stated that steps had been taken to standardize the variations in their size. Mr. Phelps also read a paper on "Plastic Refractories."

Professor Gordon B. Wilkes of the Massachusetts Institute of Technology, and L. E. Hankinson, of the West Penn Power Company also addressed the meeting.

The subject of mullite refractories will be discussed by the Pittsburgh Division of American Ceramic Society on November 3.

Foreign Glass Manufacturing Costs

Foreign production data on plate glass costs has been obtained from eight of the leading plants in Belgium by J. M. Albertson, of the Ceramic Division of the United States Tariff Commission, who recently returned from a trip to Europe which he made in connection with the investigation of the commission under the flexible tariff provision with the cooperation of manufacturers in Belgium. Mr. Albertson also made a general study of the plate glass industry in Germany, France and England, to determine to what extent the continuous process has been developed. He found that experimentation is being carried on at one Belgian plant; that no plant in Germany is using that method, and that the firm of Pilkington Bros., Ltd., St. Helen's, England, is making part of its production by continuous grinding and polishing.

A report for information of the commission and later of the trade on the domestic and foreign plate glass situation will be prepared by Mr. Albertson, who hopes to have it completed by mid-winter, after which there will be a public rehearing in the plate glass investigation.

Mr. Albertson also engaged in work on the magnesite and fluorspar flexible tariff investigations for the commission while in Europe. In Holland and England he secured figures showing costs of production of caustic calcined magnesite. In England he obtained much general information about the fluorspar industry, but did not obtain cost figures.

Industrial Research Laboratories in the United States

The continuing demand for a new edition of Bulletin No. 16 of the National Research Council which contains a list of research laboratories in industrial establishments of the United States indicates that this list apparently fills a certain need in the industrial world, and confronts the council with the fact that the material assembled in 1921 is five years out of date and should be revised at this time.

In order that a new list as complete as possible may be prepared an appeal as made to the readers of this journal who are connected with firms now maintaining research laboratories to send a post-card giving the name and address of the firms with which they are connected. Questionnaires will then be sent to these firms.

The value of such a compilation lies first in its accuracy; second, in its completeness. The completeness of this compilation can be assured only by the cooperation of those in immediate touch with the various laboratories which should be included.

Post-cards should be addressed to the Research Information Service, National Research Council, B and 21st streets, Washington, D. C.

Bureau of Standards to Celebrate Anniversary

A celebration of the twenty-fifth anniversary of the Bureau of Standards of the Department of Commerce is just announced. On Saturday, December 4, next, the Bureau will keep open house and a banquet will be given at which the many friends of the Bureau will meet the staff and reminiscences will be exchanged, the achievments of the quarter century will be reviewed, and the present and future work will be discussed. A group of distinguished guests will attend. The event is of interest to the world of science and as well to the industrial experts who have worked so closely in cooperation with the Bureau and in turn made application of its discoveries and developments in perfecting the measured control of processes. The opportunity to inspect the experimental research facilities of the Bureau will be welcomed by its many friends.

Pittsburgh Section to Discuss Mullite Refractories

At the next regular monthly meeting of the Pittsburgh Section, American Ceramic Society, a paper—"Mullite Refractories" will be given by T. F. Curtis, Director of Research, Vitrefrax Company, Los Angeles, California. The paper will be open for discussion and promises to be most interesting.

The meeting will convene at 8:15 P. M., Wednesday, November 3, 1926, Fellows Room, Mellon Institute of Industrial Research, Pittsburgh, Pa. Mr. Curtis is recognized as an authority on refractories. All of those interested are cordially invited to attend.

Glass Patent Suit Dismissed

The suit instituted by the American Window Glass Company, Pittsburgh, against the Sandusky Glass Manufacturing & Supply Company, Sandusky, O., in the United States Court, alleging infringement of patents owned by the former company and involving the Lubber patents on methods and equipment for drawing window glass, was recently dismissed by Judge Westenhaver. It was decreed that the defendant should recover full costs. The court also decreed that the plaintiffs no longer be permitted to monopolize the expired patents.

Standardization of Drafting Practice

A sectional committee of the American Society of Mechanical Engineers held a meeting in New York recently to begin the work of standardizing drafting room practice. Prof. Franklin De. R. Furman, head of the Department of Machine Design at Stevens Institute of Technology, was appointed temporary chairman, and Carl W. Keuffel, supervisor of the Optical Department of the Keuffel & Esser Company, was appointed temporary secretary of the new committee.

Glass Distributors' Annual Meeting

The National Glass Distributors' Association will hold its annual meeting December 7 and 8 at the William Penn Hotel, Pittsburgh. W. L. Mumo, president of the American Window Glass Company, has extended his usual invitation to the members to attend a banquet to be held during the meeting.

Charles M. Schwab of the Bethlehem Steel Company was recently elected president of the American Society of Mechanical Engineers.

Twenty members of the Pittsburgh section of the American Ceramic Society visited on Thursday, October 14, the Westinghouse High Voltage Insulator Company's plant at Derry, Pa., in place of holding their regular monthly meeting.

A contract for the installation of 213 plate glass windows in the S. S. *Malolo*, which is now being constructed at Cramp's Shipyard, Philadelphia, and which will be the largest and fastest high-powered passenger steamship ever built in the United States, has been awarded to the Kearfoot Engineering Company of New York.

Orders received by the General Electric Company, whose vast activities include the operation of electric bulb manufacturing plants at Cleveland, O., Bridgeville, Pa., Niles, O., Harrison, N. J., and Schenectady, N. Y., for the three months ending September 30, 1926, total $81,587,917, compared with $73,561,483 for the same quarter in 1925, an increase of 11 per cent, Gerard Swope, president, has announced. For the nine months of the present year, orders total $246,993,637, compared with $223,876,711 for the first nine months of 1925, an increase of 10 per cent.

September construction contracts in the 37 States east of the Rocky Mountains amounted to $562,371,400, according to F. W. Dodge Corporation. This was only 6 per cent under the total for the preceding month, and the decrease from September of last year was less than 1 per cent. These 37 States include about 91 per cent of the total construction volume of the country.

The most important items in the September contract record were: $225,516,300, or 40 per cent of all construction, for residential buildings; $98,166,800, or 17 per cent, for public works and utilities; $97,378,300, or 17 per cent, for commercial buildings; $49,112,700, or 9 per cent, for industrial construction; and $34,531,600, or 6 per cent, for educational buildings.

Trade Activities

The **Interstate Window Glass Company** plant at Kane, Pa., is resuming manufacturing operations.

The Delmar Glass & Mirror Company, 118 Market St., St. Louis, Mo., is reported to have increased its capital from $5,000 to $19,000.

The large tank at the **D. C. Jenkins Glass Company,** Arcadia, Ind., burst on October 10, throwing quite a large number of employes out of work for a considerable period.

The Ohio Glass Products Company plant at Massillon, Ohio, is reported sold to W. E. Hemperly, an attorney of that city, at a price said to be over $80,000. Purchase includes plant, machinery, equipment and raw materials.

The Hemingray Glass Company, Muncie, Ind., suffered considerable loss by the bursting of one of its tanks on October 10. It is reported that the tank had just previously been prepared for the beginning of operations on Monday, October 11.

The Mountain State Glass Company's old factory at Mannington, W. Va., has been taken over by the **General Flat Glass Company,** of the same city, and sheet glass drawing machines are being installed. Heavy sheet glass and glass window weights will be manufactured.

The Modern Cooperative Window Glass Company, Salem, W. Va., has been former to take over the plant and equipment and all materials of the Modern Window Glass Company. Repairs are being made and it was expected that blowing would be started before November 1.

The Louie Glass Company, Weston, W. Va., began manufacturing operations in October. Their new plant, which has been under construction for several months, is claimed to be up-to-date and very well suited to the production of clear glassware and colored and decorated glass.

At the **New Martinsville Glass Manufacturing Company,** New Martinsville, W. Va., Ira M. Clarke, has resigned as treasurer and general manager, and Robert E. McEldowney has been appointed to his place. Mr. McEldowney has been associated with the New Martinsville Company as secretary and sales manager for several years.

The Eureka Glass Company, Eureka, Kans., a new concern, is planning the erection of a factory to make art and table glassware, the cost, including equipment, to be $300,000. J. W. Fenton, of Wheeling, W. Va., will be manager. Through a sale of lots managed by the Eureka Chamber of Commerce, the city of Eureka is providing the company with $100,000.

The Abeles Glass Company, Little Rock, Ark., has been incorporated with a capital of $25,000, and will engage in the wholesale and retail sales of ornamental, structural and other types of glass. The incorporators are: T. D. Abeles, president; John R. Jones, Jr., vice-president and secretary; R. M. S. Abeles, treasurer, and Rose R. Abeles.

The Wightman Bottle & Glass Manufacturing Company, Parkers Landing, Pa., resumed operations about the middle of October after a shut-down of about two months during which time, it is reported, improvements and changes were made including the installation of a new and larger tank and the addition of another Lynch automatic machine.

A special meeting of the stockholders of the **Pennsylvania Glass Sand Company** will be held on December 2 to vote on conversion of its stock of $100 par value into stock of no par value; determining the number of shares to be issued on such conversion and fixing the capital for the company in connection with the provision of such shares without nominal or par value.

R. W. Anderson, assistant to the president of the United States Glass Company, Pittsburgh, has resigned to take charge of the Tidewater Glass Manufacturing Company, Jacksonville, Fla., makers of glass containers for packers' use, which has been reported to have been purchased by Pittsburgh interests. The plant is being improved and three Bethel feeders will be installed.

Recent Deaths

Adolphus A. Adams

Adolphus A. Adams, 75 years of age, a pioneer glass manufacturer, died at his home in Pittsburgh early in October. While still a young man Mr. Adams entered the glass business with his father under the name of John Adams & Company, the concern later being absorbed by the United States Glass Company.

W. H. Fisher

W. H. Fisher, head of the traffic department of the United States Glass Company, Pittsburgh, Pa., died at his home in the Knoxville section of that city on October 15. Mr. Fisher was 57 years of age and was born in Steubenville, Ohio.

Coming Meetings

THE AMERICAN CERAMIC SOCIETY'S annual meeting will be held at the Book-Cadillac Hotel, Detroit, Mich., during the week February 14, 1927.

THE AMERICAN BOTTLERS OF CARBONATED BEVERAGES will hold its eighth annual convention and exposition at Buffalo, N. Y., November 8 to 12, 1926.

THE NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace, New York, December 6 to 11, 1926.

THE NATIONAL GLASS DISTRIBUTORS' ASSOCIATION'S annual meeting will be held at William Penn Hotel, Pittsburgh, December 7 and 8, 1926. The Eastern Division will hold its next meeting in New York, November 8 and 9.

What the World Wants

Specific Inquiries for American Goods Received in the Department of Commerce

Egypt: 22412, 10- or 12-ounce bottles for lemonade, 5,000 and 1,000 gross tin caps.

New Zealand: 22431, window glass, plain, leaded or plate; 22556, glass tumblers or jars, of 6 and 10 ounces, with patent tops.

South Africa: 22608, glass, silvered and beveled.

Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, SEPT. 21, 1926.

Reported by Moore, Leonard & Lynch, Union Trust Building, Pittsburgh, Pa.

	Bid	Asked	Last
American Window Glass Machine, com...	58	58	58
American Window Glass Machine, pfd....	81	81	80
American Window Glass, pfd.....	107	..	107
United States Glass.....	16	16½	16
Pittsburgh Plate Glass, com.....	278	..	280
Standard Plate Glass, com.....	..	..	5½
Standard Plate Glass:			
Preferred cumulative	30	35	32
Prior preferred	80	..	81½

TOLEDO STOCK EXCHANGE, OCTOBER 21, 1926.

Owens Bottle Machine, com.....	114¼	116	116¾
Libbey-Owens Sheet Glass, com.....	141	142	140
Libbey-Owens Sheet Glass, pfd.....	115	...	116

WHEELING STOCK EXCHANGE, SEPTEMBER 22, 1926.

	Bid	Asked	Last
Hazel-Atlas	..	..	49
Imperial	..	..	72
Fostoria	..	..	150
Central	..	..	75

Situations Open

CHEMICAL SALESMAN

WANTED: Salesman, preferably chemist, for chemicals, colors and other preparations for ceramic industries, especially glass plants. State age, experience and qualifications, also salary expected. Address, SALESMAN, care GLASS INDUSTRY, 50 Church street, New York.

Current Prices of Glass-Making Materials

October 22, 1926

Quotations furnished by various producers, manufacturers and dealers

		Carlots	Less Carlots
Acid:			
Citric	lb.	.44½	.44½
Hydrochloric (HCl) 20° tanks, per 100 lb.		.95-1.05	..
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.15
52% and 48%	lb.	..	.10½-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	5.75
Sulphuric (H_2SO_4) 66° tank cars	ton	15.00-16.00	..
Tartaric	lb.	.27½	.28½
Alcohol, denatured	gal.	..	.40
Aluminum hydrate ($Al(OH)_3$)	lb.	.06	.07
Aluminum oxide (Al_2O_3)	lb.	..	.05
Ammonium bifluoride (NH_4FHF)	lb.	..	.21-.22
Ammonia water (NH_4OH) 26° drums	lb	..	.03½
Antimony, metallic (Sb)	lb.	..	.14½
Antimony oxide (Sb_2O_3)	lb.	..	.16½
Antimony sulphide (Sb_2S_3)	lb.	.15	.16½
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.03½	.04
Barium carbonate ($BaCO_3$)			
Precipitated	ton	49.00-55.00	51.00-58.00
Natural, powdered, imported	ton	42.00-44.00	45.00-46.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	.48
Barium nitrate ($Ba(NO_3)_2$)	lb.	.07½	.07¾
Barium selenite ($BaSeO_3$)	lb.	..	..
Bone ash	lb.	.05	.05½
Borax ($Na_2B_4O_7 \cdot 10H_2O$)	lb.	.04¾	.05-.05½
Boric acid (H_3BO_3)	lb.	.09	.09¾
Refined	lb.	.08½-.09	.09-.09½
Cadmium sulphide (CdS)—			
Red	lb.	..	1.20
Orange	lb.	..	1.05-1.25
Yellow	lb.	..	1.20-1.40
Chromium oxide (Cr_2O_3)	lb.	.30	.30-.35
Cobalt oxide (Co_3O_4)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	30
Black (CuO)	lb.	..	.25-.30
Black prepared	lb.	..	.30
Cryolite (Na_3AlF_6) Natural Greenland Kryolith)	lb.	..	.09½-.09½
Artificial or Chemical	lb.	..	.09
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		1.20	1.35
Feldspar—			
100 mesh	ton	11.00-20.00	16.00-22.00
80 mesh	ton	13.50	..
40 mesh	ton	..	..
Fluorspar (CaF_2)—			
Powdered white, 95%	ton	40.00	40.00
" " 90%	ton	38.00	..
Formaldehyde	lb.	.10¼	.10¾
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.02-.03
Black (FeO)	lb.	..	..
Kaolin (f.o.b. mine)	ton	10.00	..
English, lump, f.o.b. New York	ton	13.00-23.00	..
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb	..	.11¾
Litharge (PbO)	lb.	..	.11¼
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	2.30
Limestone ($CaCO_3$)		2.00	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.04	.04½
light (in bbls.)	lb.	.22	.24
extra light (in bbls.)	lb.	..	.32-.37
Magnesium carbonate ($MgCO_3$)	lb.	.06¼	.06¾
Manganese 85% (MnO_2)	lb.	.04¾	.05
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	..	.35
Nickel monoxide (NiO), green— for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	..	19.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.08	.08¼
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.06½	.06¾
Hydrated 80-85%	lb.	.05¾	.06
Potassium chromate (K_2CrO_4)	lb.	..	.27
Potassium hydrate (KOH) (caustic potash)	lb.	.07⅛	.07⅝
Potassium nitrate (KNO_3) (gran.)	lb.	.05⅞-.06	.06⅛-.06¼
Potassium permanganate ($KMnO_4$)	lb.	.14	.14½
Powdered blue	lb.	..	.24-.26
Rochelle salts, bbls.	lb.	..	.20-.22
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	20.00-22.00	25.00-35.00
Selenium (Se)	lb.	..	2.10-2.15
Silver nitrate ($AgNO_3$)	oz.	..	.40
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat per 100 lb.	1.35-1.40	..
Bulk, on contract	Flat per 100 lb.	1.35	..
In barrels	Per 100 lb.	1.69	2.40
In bags	Per 100 lb.	1.45	..
Spot orders .05 per 100 lbs higher			
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06¼	.06¾
Sodium hydrate (NaOH) (caustic soda)	Per 100 lb.	3.60	4.16
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04¼
95 per cent.	Per 100 lb.	2.49	2.75
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.05	.05½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.10-1.30
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.45	3.80-4.00
Flowers, in bags	Per 100 lb.	3.10	3.45-3.65
Flour, heavy, in bbls.	Per 100 lb.	2.85	3.20-3.40
Tin chloride ($SnCl_2$)) (crystals)	lb.	..	.47
Tin oxide (SnO_2) in bbls.	lb	..	.70
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots	lb.	..	1.30-2.25
Zinc oxide (ZnO)	lb.	.07½	.07¾

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to September 24, 1926

	August 1925 Quantity	August 1925 Value	August 1926 Quantity	August 1926 Value	Eight Months Ending August 1925 Quantity	Eight Months Ending August 1925 Value	Eight Months Ending August 1926 Quantity	Eight Months Ending August 1926 Value
Glass and glass products (total)	.....	681,569	.....	711,037	.....	5,633,432	.....	5,889,117
Plate and window glass—								
Window glass, common, box 50 sq. ft.	1,729	8,522	1,941	10,654	18,114	103,251	21,417	120,255
Plate glass, unsilvered, sq. ft.	103,586	29,454	80,378	25,251	954,622	265,221	775,572	197,813
Other window and plate glass lbs.	284,502	37,201	210,134	27,826	1,457,800	175,099	1,562,593	162,688
Glass containers (bottles, vials and jars)	.....	199,904	.....	268,406	.....	2,007,990	.....	1,966,948
Table glassware, plain	.....	140,606	.....	115,225	.....	1,154,352	.....	1,072,223
Table and other glassware, cut or engraved	.....	14,672	.....	10,527	.....	102,043	.....	117,380
Lamp chimneys and lantern globes lbs.	200,790	37,512	182,712	31,354	1,346,064	239,772	1,514,722	279,635
Globes and shades for lighting fixtures lbs.	130,277	46,284	116,047	43,949	1,045,126	320,789	1,125,740	368,660
Chemical glassware lbs.	20,518	20,313	15,045	15,003	149,101	124,125	142,973	132,720
Electrical glassware, except for lighting lbs.	185,338	23,917	450,701	30,034	2,088,053	187,066	3,993,965	337,497
Other glassware	.....	123,184	.....	132,808	.....	953,724	.....	1,133,298

IMPORTS

Corrected to September 24, 1926

Glass and glass products (total)	.....	1,482,680	.....	1,768,375	.....	11,639,198	.....	13,702,521
Cylinder, crown and sheet—								
Unpolished dut. lbs.	2,934,816	161,515	6,815,768	222,736	33,301,476	1,762,681	54,089,062	2,198,186
Bent, ground, beveled, colored, painted, etc., and polished dut.	.....	43,111	.....	28,248	.....	386,618	.....	376,494
Plate glass dut. sq. ft.	1,174,536	533,636	2,214,876	732,156	11,878,789	5,432,624	18,255,361	6,026,241
Containers—bottles, vials, etc. dut.	.....	14,529	.....	21,923	.....	117,133	.....	189,767
Table and kitchen utensils dut.	.....	21,929	.....	8,829	.....	80,365	.....	53,870
Glassware, cut or decorated dut.	.....	236,500	.....	300,992	.....	1,343,813	.....	1,728,569
Blown glassware, n.e.s.—								
Bottles, ornaments, etc. dut.	.....	219,222	.....	209,614	.....	735,364	.....	1,012,899
Bulbs for electric lamps dut. No.	512,229	8,926	1,369,092	14,585	12,402,195	129,107	12,684,776	141,621
Chimneys, globes, shades, etc. dut.	.....	77,571	.....	78,859	.....	725,571	.....	680,619
Articles and utensils for chemical, scientific and experimental purposes dut.	.....	41,112	.....	38,383	.....	217,793	.....	374,374
Other glassware dut.	.....	124,629	.....	112,050	.....	708,129	.....	919,881